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ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

Financing the Prospect

How the fraudulent mine promoter makes legitimate development difficult; and a proposed remedy

By Arthur B. Parsons

Ore Injection at Edwards, New York

By J. E. Spurr

Borehole Surveying by the Kiruna Method

By Sven Lundberg

Gold Mining on the Rand, South Africa

Drilling a round with a water tube rotator in a narrow underhand stope of Crown Mines, Ltd.

Mine operators prefer S-A all-steel, ball bearing Unit Carriers

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 117 New York, April 26, 1924 *Number* 17

Surplus and Shortage

THE CLIMAX of a recent story in the *Saturday Evening Post* comes when the hero, the owner of a ranch in the great wide spaces of the West, announces that, quite by accident, he has discovered that his whole ranch is underlain by "solid porphyry," and that with the $50,000 he has just won on a horse race he proposes to follow up the clew and develop one of the biggest copper mines of the world. To which one might have wished to reply to the hero that, although it was evident that his dome was "solid ivory," he was still very far from developing into a billiard-ball factory.

The "porphyry coppers" have evidently impinged upon the popular imagination. Many of the copper-bearing porphyries are monzonites, a fact which long ago aroused interest among mining men as to what monzonite might be. "What is monzonite, anyhow?" one mining man asked another. "As near as I can find out," was the reply, "monzonite is an igneous rock controlled by the Guggenheims."

The discovery of the disseminated copper deposits, made into low-grade ore by secondary sulphide enrichment by downward-percolating atmospheric waters—a group which has received the colloquial and commercial sobriquet of the "porphyry coppers"—has had vast economic consequences. Had it not been for Jackling's success with Utah Copper and the subsequent successful opening up of other great low-grade mines, the copper-mining problems which we now have would not exist. Instead of an overproduction, we should have a world shortage, with high prices for the metal. It is analogous to the oil discoveries in California last year, which flooded the market and unexpectedly lowered the price of petroleum to the point where there was little or no profit. At any rate, a fair supply of copper is guaranteed the world for some decades.

With enlarged demand for metals, as a rule new supplies are discovered; and higher prices bring about a larger production from mines already known. This is an exceedingly ephemeral condition, as the world will some day chronicle; nevertheless, it is satisfactory for the current period.

The greatly increased demand for arsenic as an exterminator of the cotton boll weevil has been met. We have a great deal of arsenical ores, in many parts of the country, that can be mined, if mining be made financially worth while. We have more molybdenum than the demand calls for—we could respond to an increased demand. On the other hand, our supply—indeed, the world's supply—of mercury is very limited. We called attention some time ago to this fact; and to the likelihood that the spread of the use of mercury in steam boilers would run against this snag of insufficient material. This fact, as pointed out, has naturally given pause to those who were contemplating the unrestricted adoption of the new invention. Some commentators, however, have been inclined to brush this consideration aside, and to believe that a somewhat heightened price would bring out all the mercury needed. To this we must interpose a firm statement of our belief to the contrary.

We are already confronted with the advance guard of world shortages of metals—of the sheer inability of industry to find enough for its uses. Mercury is an example of this. The answer? Substitution. Industry will go on, finding substitutes—substituting one metal for another. We shall probably never have a real world shortage of the principal industrial metal, iron. When the oxides are gone—which will be at a remote future date—the world will mine the silicates.

Mining is one of the most ancient of industries—it is safe to say that it will prosper as long as men and civilization survive.

Magma Smelter Blows In

THIS MONTH we have chronicled the blowing-in of a brand new copper smelter, the first that has been built on this continent, we believe, since the United Verde Extension erected its own plant in the Jerome district of Arizona, back in 1918. Unfortunately, the new works of the Magma Copper Co. has not been erected because existing smelting facilities are inadequate, however. Formerly, the Magma concentrates were transported 28 miles by the company's own railroad, and then 53 miles over the Southern Pacific to Hayden, where they were smelted along with the Ray Consolidated product, by the American Smelting & Refining Co. Favorable developments underground, a planned increase in output, high costs of rail transportation, and the cost of custom smelting combined to cause the Magma directors to decide to build their own reduction plant. It would be interesting to know how the costs at the new plant will compare with those that had to be met with custom smelting; this information would make an interesting paragraph in some future annual report.

The smelter superintendent and his assistants are to be envied in having a new plant to work with, despite the inevitable troubles of the first few weeks of operation. So many of our copper smelters are poorly arranged, according to modern ideas; so many additions have been made where there was room for them, rather than where they would be most convenient, that it must be a great satisfaction to have things placed where they should be. With the present high cost of labor, a very decided saving should be made in this item.

Though it has become fashionable to have A. G. McGregor design Southwestern copper smelters, the San Francisco firm of Bradley, Bruff & Labarthe were

engaged to build this one; heretofore they have specialized more in flotation and cyanide plants, but the layout they have provided for the new Magma smelter looks like a success. Herreshoff roasters will be used, a reverberatory for smelting, and a couple of the upright Great Falls type of converters for oxidizing the matte to blister copper. We hope to publish a complete description of the equipment soon.

We welcome this latest addition to the ranks of copper smelters, of which there are now about forty in active operation on this continent. It makes the Magma Copper Co. a self-contained enterprise from mine to finished metal, if blister copper may be called such. The prospects of the company seem particularly encouraging, even with the present unsatisfactory prices obtained for copper.

Gyrations of the Tin Market

THE TIN MARKET is like that of none of the other metals, prices being almost entirely controlled by one or two London speculative interests and largely governed by the well-known metal house of Ricard & Freiwald. New York quotations merely reflect the course of London prices and sterling exchange. Daily fluctuations of as much as a cent up or down, and sometimes more, are a common occurrence, and the tin price curve has a decidedly serrated character as a consequence. Recently, another London firm of metal dealers, apparently backed by ample capital, has entered the game, resulting in fluctuations even greater than usual and a sudden drop in prices of £25 per long ton in three days. The gyrations in the tin market have destroyed all confidence of American consumers and have made them unable to adopt any settled policy of providing for their future requirements. Bolivian producers are also reported to be up in the air. In the Santiago and Valparaiso stock markets dealings in tin shares have had to be suspended.

The condition of the tin market is perhaps one of the best arguments for the practice of American copper and lead producers in selling direct to consumers only.

World Scope of the *Mining Journal-Press*

WITHOUT OVERLOOKING or diminishing its major task of representing the mining industries of the United States, the steady growth of the *Engineering and Mining Journal-Press* as internationally accepted authority on the mining industries is evident from many indications, one of the most tangible of which is the reports of our Circulation Department. The list frequently shows that out of our total net paid circulation (we have no dead-head circulation and no exchange list) nearly 30 per cent (29.33 per cent) is from countries outside of the United States. This compares, for example, with a circulation analysis of the *Engineering and Mining Journal*, taken at random, in 1920, when the total percentage of circulation outside the United States was 23.7 per cent. The change cannot be laid to the consolidation with the *Mining and Scientific Press*, which had a smaller foreign circulation than the *Engineering and Mining Journal*. It must be laid to the growth of the consolidated *Mining Journal-Press*—through its editorial policies, its news, its technical papers, and its general coverage.

To show this striking tendency in another way, since the 1920 analysis referred to, our total net paid circulation has increased 12.7 per cent; while that part of the net paid circulation which goes to countries outside the United States has increased 39 per cent! It is not figurative, therefore, when we take ourselves as a world mining journal. After all, the problems of mining are mundane—or at least international—more than they are national questions.

Compensation Insurance and Medical and Hospital Expenses

EMPLOYERS should protect themselves by carrying compensation insurance. This reduces the financial hazard of operation to a known factor. Although the annual outgo may be appreciable, several accidents may easily account for more. An instance is given by the Industrial Accident Commission of California where an employer paid $11,339 for an injury to one of his employees. Of this sum $9,000 was for medical and hospital expenses and the remaining $2,339 for disability indemnity.

Of interest is the large toll collected by the "human repair garages." We are of the opinion that the employer having an injured employee on his hands is sometimes subjected to the "courtesy" that is meted out to the wealthy patient. Whatever the responsibility —and in some instances the employer is guilty of gross neglect—industry should not be penalized.

Industrial compensation insurance has relieved many of the abuses to both employee and employer and is the practical way to finance the accident risk. Only large companies can maintain hospitals and finance their own accident insurance. To the small operator industrial accident insurance companies and state compensation insurance afford a means to provide against these contingencies.

Petroleum Situation Changing

NEW CONDITIONS are shaping for petroleum producers, and one result may be a general price advance. Consumers have profited from the long-continued overproduction at the expense of producers, but conditions are gradually coming back to normal, and in California, where the mischief began, producton has now fallen to about 650,000 bbl. per day, compared with almost 900,000 bbl. at the peak of the flush period. Total production of the country is still high, around 1,950,000 bbl. per day, but cannot hold this rate long unless new fields are found.

Despite conditions that have prevailed, very little petroleum has been kept off the market that might otherwise have been produced. Some heavy fuel oil has been shut in, but there has been little or no curtailment of production that was good for gasoline purposes. Last spring, when the Californian flood was worrying Mid-Continent producers and pipe-line companies announced that they would pro-rate runs in the hope of preventing further price declines, it was said by some that wells would be lost and producers bankrupted by such a policy. But curtailment to any appreciable extent did not materialize. The period of proration, which began on June 26, lasted about four months, and the amount of oil affected was small, for

the reason that proration, by force of circumstances, applied chiefly to the small producers. Gradually then, without announcement, the pipe lines took more and more oil, buying it as they saw a market, until the matter of proration was a fiction rather than a fact. Elsewhere in the country there was no particular effort at curtailment.

That a change is pending in the domestic petroleum industry is the view expressed by Dorsey Hager in his article in the *Mining Journal-Press* of April 19: the period of depression is almost over and prosperity for the producer is near. Only the continuance of overproduction can delay it, something that cannot happen unless other new gusher fields like Santa Fe Springs and Huntington Beach are found. Such discovery is very unlikely, according to Mr. Hager, who reviews the chances of new finds in the various states. Only Texas and Louisiana look promising to him, though he admits the possibility of the unexpected.

However, there will be no oil shortage, he says, for a while anyway. As consumption races ahead of domestic production, imports will make up the deficit. General use of fuel oil, especially for domestic purposes cannot be considered, as the price would become prohibitive, Mr. Hager believes, adding "unless oil-shale deposits are developed." This last phrase should be taken conservatively. Large sums will be needed to develop an oil-shale industry to a point where it will yield any large amount of oil. But that is in the future, though something to be considered. In our opinion, the future promises most for those petroleum producers who will be able to import cheaply.

Varying the Price of Gold

ACHIEVEMENTS seldom bring the satisfaction that is anticipated; a desired change is sometimes found to conflict with fundamental laws, and the expected improvement fails to eventuate. These comments are inspired by recent misgivings in South Africa anent the "price" of gold. When an abnormal amount of British paper money was needed to purchase an ounce of gold, we heard much of the high "price" of that essential prop to national stability. Those in favor of a "premium" in other countries, who objected to the immutability of the price at $20.67 per ounce, were impressed with the notion that the gold miners in the Transvaal were better off. Then the "price" of gold in South Africa fell as sterling-dollar exchange approached parity; and the economic readjustment was viewed with misgivings. More recently there has been a tendency for the "price," in terms of paper currency, to rise; whereupon one South African contemporary expresses uneasiness at the prospect of an increase in the cost of living, due to the depreciation in the value of the pound sterling in terms of the United States dollar. It is argued that the immediate effect of the change would be detrimental to the wage earner were it not for the fact that the shortage of cash has forced the selling of goods at slump prices, a condition that cannot last indefinitely.

Disappointment may follow realization, whatever happens. The only solution of the difficulty is to maintain a fixed price for gold in terms of currency exchangeable for gold. If this is impossible, fluctuations in the apparent price of gold are inevitable, thus disturbing the economic stability of the country.

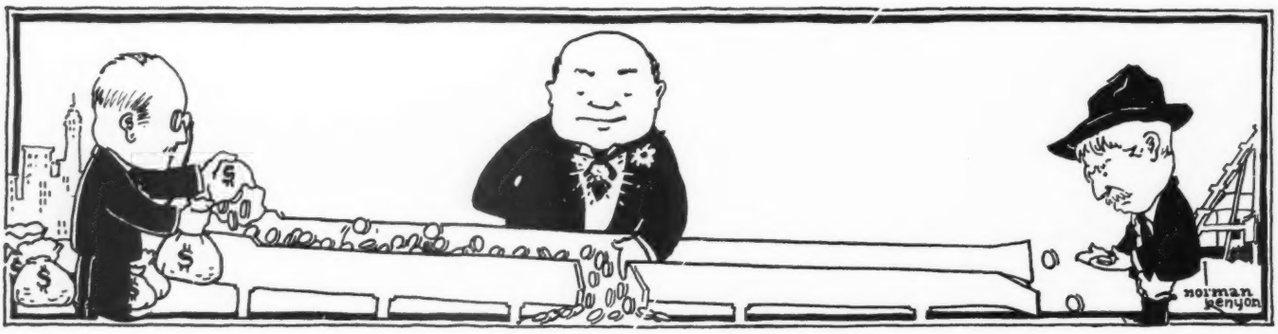
The Dawes Report

CONSIDERING the restrictions, political and otherwise, imposed upon the deliberations of the Dawes Committee on Reparations, the report of that body is remarkable for its recommendations. That it is a definite final solution to the greatest unsettled commercial problem in the world today no one will be rash enough to admit, for the committee has had to ignore the vital psychological factor of determining the total sum that Germany must pay. Without a decision as to this amount, the reparations question remains open. Obviously, it will affect Germany's incentive to discharge her obligations. However, the committee has grasped the economics of the situation and proposes a plan that is ingenious to the extreme. In view of the great importance of a settlement of the reparations dispute to raw materials industries in the United States, the essentials of the Dawes scheme are worth careful study by all mining men.

The ingeniousness of the Dawes report lies in the fact that it divorces the collection of wealth in Germany (mainly taxes collected in paper marks) and the transfer of this money to the creditor countries. A new bank is provided in which German internal reparations payments are to be deposited. These payments are to be transferred to other countries only when this can be done without serious dislocation of German exchange. In other words the report recognizes the evils of currency fluctuation and depreciation, and makes the stabilization of the mark one of its major objects. If German payments cannot be safely transferred to, say, France or England, they will remain in the new bank, or be invested in German industry.

The Dawes Committee also recognizes that reparations can be paid ultimately in no other manner than through a surplus of exports over imports, visible and invisible, a statement repeatedly made by the committee and one which we have emphasized again and again in these pages. This should set at rest the proffered opinions which argue the possibility of other means of payment. The report will also confound those critics who have maintained that Germany has enormous credits abroad which should be seized for payment. The $1,700,000,000 of German wealth outside of Germany is only a fraction of what is demanded from the country; and a good portion of it is being used to maintain Germany's trade with other countries.

Despite its limitations, the Dawes report provides the economic machinery for collecting of reparations in such a fashion that the amount Germany can pay each year will not be left to the arbitrary decision of politicians. For that reason it is a great stride forward. Germany has already signified a willingness to accept the report; the other interested countries are expected to do likewise. It will then be up to the bankers to arrange for the necessary $200,000,000 loan to Germany—a loan that will probably have to be absorbed mainly by investors in the United States. This will be no easy task, as the security back of the loan, its priority over reparations collections, and other details remain to be decided before the success of the bond issue is assured. At any rate the Dawes report is a start in the right direction. Copper producers especially should be gratified at the progress that has been made and hope that the good beginning will be continued.



The One Big Trouble

Financing the Prospect

How the Fraudulent Mine Promoter Makes Legitimate Development Difficult; and a Possible Remedy

By Arthur B. Parsons
Assistant Editor

EVERYONE who knows anything about fraudulent mine promotions during recent years has heard of an individual who has assumed, for reasons best known to himself, a name that happens to be that of the principal food of most of mankind. Although he still is in "business," a newer generation of promoters, nervier, shrewder, smoother than he, has developed the art of fleecing the public with worthless mining shares beyond anything that he ever conceived. The technique has been improved, but the underlying philosophy is the same as set forth by him years ago: "The world is full of people who have more money than common sense. These people are swarming around everywhere with their hands full of $20 banknotes anxiously looking for somebody to take the stuff from them. Investment bankers, brokers, and operators in Wall Street and Bush Street and in hundreds of other streets get what they can; why am I not entitled to reach out and grab some of the easy money myself?"

If the facts are faced it must be admitted that there is some truth in what he says. The optimistic and avaricious public, including doctors, lawyers, and other professional men, merchants, manufacturers, landlords, salaried people, large and small—oh no, editors and mining engineers are not exceptions!—are continually supplying the millions that keep the bearish brokers, the professional traders, the manipulators, on Easy Street. The victims think they are speculating, but they haven't a chance against their astute and cold-blooded opponents; in the long run not one in 1,000 wins. Of course, it is the fatuous hope that they may land in the lap of Fortune that makes the stream of "suckers" endless. The contention of this notorious mine promotor, that "respectable" Wall Street stacks the cards just as surely as he himself and that he is entitled to share in the harvest is at least understandable.

The trait of human nature, the gambling instinct if you wish to call it that, that makes his original premise true, enables the owner of the prospect or the partly developed mine to enlist public assistance in financing further work; yet, paradoxical though it may be, the fact that so many unscrupulous mine promoters operate in accordance with his theory is the thing that today makes it so difficult for the honest mine owner to raise the money that he needs.

It is unfair to characterize the purchase of shares in an unproved mining venture as throwing money away. If the project is equitably financed and honestly and competently managed it is a far better gamble than playing the part of a Wall Street "lamb." But on account of the inherent risk, any new mining enterprise is a speculative venture; and it is quite proper to say that the human thirst for taking a chance, possibly more parching in America than elsewhere, has made it possible to finance mine development by public participation. Nevertheless, the operations of the dishonest promoter, or broker, or salesman of fraudulent mining stock, by consuming most of the money available and by bringing all mining shares into disrepute, has made the financing of legitimate mining ventures most difficult. Before I get through I will make clear the difference between an honest mine speculation and a fake stock-selling enterprise.

Embryonic Mines Must Be Financed

It need not be pointed out here that the welfare of the public at large as well as of the mining industry requires the adequate development of our mineral resources and that this cannot be accomplished unless the embryonic enterprises are financed. Some of the people who are swindled by purchasing worthless shares deserve no sympathy; others are entitled to sincere sympathy. But this article does not particularly consider the victim. The problem is to be approached solely from the standpoint of the owner of a first-class prospect, the partly developed mine, with the idea of answering as specifically as possible the following questions:

What methods are available to him for raising the money for further development of his property?

What terms will he have to meet?

How do "high-pressure" promoter-salesmen and their brokers operate?

Wherein is the whole system adverse to the interests of the "small mine" owner?

What course of action holds out the best chance for improving the situation?

Of 1,000 prospects with reasonably good showings probably 999 require money in considerable amount, either to prove that they are valueless, or, if they are really good, to put them on a self-sustaining basis of production. Say that $100,000 is an average figure. Four ways for trying to get this money are available to the owner. They may be used separately, successively, or in some cases in combination:

1. Sell, generally under a bond and option, to one of the big exploration companies.
2. Organize a company and sell shares through personal acquaintance.
3. Organize a company with the assistance of a square-dealing promotor or broker and sell stock to the public on a legitimate basis.
4. Associate himself with unscrupulous brokers or promoter-salesmen and lease or option to them either the property or blocks of shares in a company that he himself has organized.

This last method, of course, is an improper one, but, unfortunately, many who are at least up to the average in honesty have dealt with crooks of this stripe, sometimes in ignorance of what they were going into, sometimes in desperation at being unable to finance development in any other way. Almost invariably the experiment has been disastrous. Little or no money has been made available for mine development, and the owner has found himself maneuvered out of a large, if not his entire, interest in the property. However, because of the important part played by the operations of the crooked stock dealer they must be considered.

Exploration Companies Want Only the Best

The first three of these methods can be discussed quickly. The big exploration or mining companies can get such prospects as they want on very easy terms. For example, if the property looks very attractive they may finance the development on a bond-and-lease basis, agreeing that if a mine is made they will give the former owner 40 or perhaps 45 per cent of any net profits after all cost of equipping and development work has been repaid. The cost of development work frequently includes sundry heavy eastern-office and other overhead expenses. The one-time owner of course loses any voice in the control, and at best is likely to have a long wait before he realizes any profit. Nevertheless, this is frequently his best course, if he is able to get a purchaser, which is not generally the case, for the big companies are interested only in the almost proven mine.

The second course, to form a company and solicit the help of personal friends or friends of friends, is seldom practical, because few owners of prospects have a sufficiently wide and a sufficiently wealthy circle of friends to obtain the necessary amount of money. The owner may raise a few thousand dollars and do sufficient work to warrant still further development, but the chances are that his resources will be exhausted long before the mine has been developed and equipped for self-supporting operation.

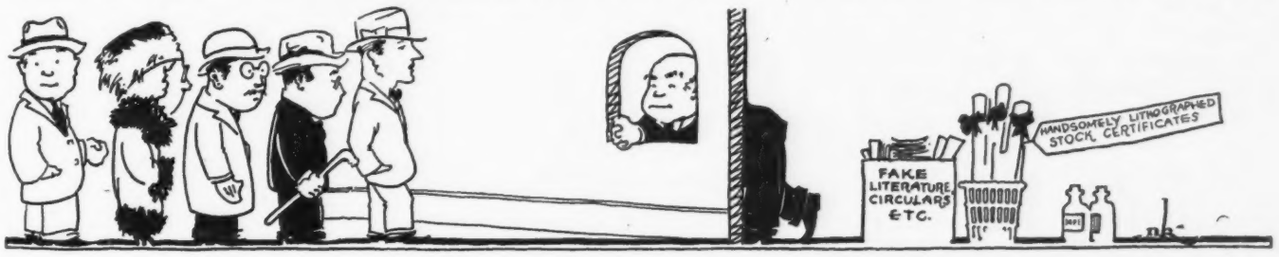
The third plan, to sell stock on a legitimate basis to the public, is the most desirable and ought to be reasonably successful. That it is not is due to the fact that the shares at once come into competition with offerings of the fraudulent promoter-salesman and broker, who have all the best of it because they are unscrupulous. The hope of the future, it seems to me, is to eliminate these swindlers, or rather to outlaw the kind of stocks that they sell. To show why they have such a tremendous advantage over the man who is endeavoring to market stock legitimately, it will be well to explain in some detail just how they operate. This at the same time will indicate the measures that should help in suppressing their activities; a thorough understanding of an evil is necessary before means of curbing it can be intelligently prescribed.

Three methods are available: (a) A broker having a seat on an exchange may market the stock without the aid of an organization to "peddle" shares by personal solicitation. (b) A group of high-pressure salesmen may distribute the stock to the public without listing or trading on any exchange. Or, (c) a co-operative arrangement between a sales organization and one or more brokers with exchange connections may be established. This last usually is the most effective way.

There are, of course, many variations in technique, but the principles are much the same in every instance; they can best be made clear by a typical illustration in which a promoter in New York has two brokers on the Curb Exchange as allies.

Typical Experience of the Prospect Owner in New York

Suppose that Jim Smith comes to New York to raise money to develop a good average prospect with a showing of lead-silver ore that would warrant a first-class engineer in recommending an initial expenditure of $50,000 for further development if a lease and bond could be obtained on terms favorable to the lessee. About the time his expense money is exhausted and he is ready to go back and get to work he falls into the clutches of a fake promoter, who after hearing his story assures Smith that he easily can get him $200,000 in sixty days. Discouraged, Smith grasps at the straw and does as he is told without knowing what really is going on. For a small fee a shyster lawyer incorporates a company—5,000,000 shares at a dollar a share. If it had happened that a company had previously been formed by Smith and his friends and a considerable number of shares had been issued and sold, it would be necessary to reorganize in order (1) to provide an exorbitant number of shares—the frauds are always



Doctors, lawyers, salesmen, merchants, clerks, landlords, actors, farmers: Mr. Average American

overcapitalized—and (2) to preclude the possibility of issued shares being put on the market by "outsiders" at an inopportune time. It is necessary that the manipulators hold all of the stock. The new company probably will take an option to purchase a controlling interest in the old company; it may get a bond and lease on the property itself; or it may acquire title to the property by allocating a block of newly issued shares to the former owners. The promoter takes 500,000 shares for his services as organizer and in addition gets an option for six months on 1,000,000 more at 5c. each. If stock has been issued in payment for the property or lease an agreement is made to put the shares in escrow so that they cannot be used to interfere with the selling campaign.

Mr. Stock Salesman Is a Hypnotist

The next step is to prepare a prospectus on the property. This may be quite an elaborate booklet or merely a simple circular letter. At any rate it is the skeleton of the hypnotizing selling talk of the salesmen who

The "high-pressure" stock salesman

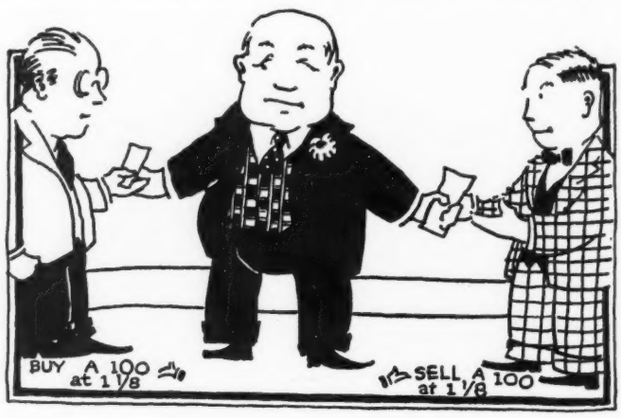
are to do the personal soliciting for the promoter on a commission basis. It is astonishing how few real facts are necessary for a top-notch mining-stock salesman. He probably never saw a mine and wouldn't know a mine if he should see one. He does not care whether the mine is likely ever to produce a pound of ore; his business is to "place the paper"—to sell the stock. He begins by telling of the vast fortunes that have been made from mining. He mentions names of well-known men whose wealth has come from mines, and he tells of the dividends paid by Anaconda, Utah Copper, Homestake, Calumet & Hecla, and Bunker Hill. He dwells on the proximity of the property to other mines that have paid huge dividends. Although a separation of a hundred miles, or so, is inconsiderable in his estimation, a closer neighbor is of course a greater asset.

He has a map, preferably taken from some government report, showing that a straight line connecting the Coeur d'Alene district, in Idaho, and Park City, in Utah, passes through his property; this he interprets as prima facie evidence that the location is geologically favorable. He quotes from "eminent" geologists and engineers whose connection with the property may be no more intimate than having reported on the general geology of the district. He has drawings that show the vein as wide, as regular, as strong, and persistent as the most exacting could wish; and he has assay reports—perhaps facsimiles of assay certificates. His "customers" do not know that a thousand assays can be made from a water pail full of picked specimens. He has a set of figures showing that if 1,000 tons of $75 ore is mined and milled each day at a cost of $10 per ton the annual net income will be $19,500,000, allowing conservatively for only 300 days' operation. Anybody that is at all quick at figures can check this for himself! And all that is necessary to start the marvelous flow of wealth is to get $300,000 to build the first unit of a flotation plant (mysterious new process that makes a better recovery of the lead and silver than used to be possible)! Accordingly "we are offering an opportunity to a few privileged folks to subscribe to a small block of treasury stock at $1 per share," declares the immaculately attired salesman in his suavest manner.

You ask if that kind of stuff "gets over"; and I assure you that it does, in any big town or any little town from Augusta, Me., to San Diego, or from Key West to Seattle. If the victim has not already reached for his check book the clinching argument is this: "As a sound investment, something to put away in your safe-deposit vault to bring in regular dividends, this stock cannot be surpassed; if, on the other hand, you desire to make a quick turn I may assure you confidentially that within thirty days this stock will be listed on the New York Curb and other leading exchanges in the country and it will be pushed to $5 at once." And here really is the shot that tells; it strikes the cupidity nerve. Something for nothing. "Even if the salesman is overly optimistic and it only goes to $2 I will double my money in thirty days"; and that is how the well-to-do "sucker" reasons and gets caught.

Sometimes there is no intention of ever listing the stock on the exchange. In that event the promoter can go ahead as long as "business" is good, selling for whatever he can get in excess of the few cents that the shares stand him and the commission to the salesman. He probably will send small sums to Jim Smith who has gone back to open up the mine. It is desirable to have a few miners at work so as to lend color to reports of favorable developments that are bulletined to prospective purchasers of shares. But in the end Smith is unlikely to get more than a small proportion of the little that is coming to him.

The more elaborate scheme involves actual trading in the shares on an exchange, preferably the New York Curb, because its quotations are broadcast everywhere on tickers and in the financial pages of the news-



Matching orders

The doctor reads the story on the tape at his own club

papers. The stock may or may not be listed; the listing costs something, but it may add a little prestige to a stock that needs bolstering. Through the Curb brokers, his confederates in the scheme, the promoter, who with Smith owns all of the newly issued stock, "washes" sales, boosting the quotations a few cents each day. This practice consists of matching buying and selling orders; although no stock actually changes ownership, a fictitious "sale" is recorded as having been made. Washing sales is against the rules, it is true; but it is done constantly on the Curb and is not unknown even on the Big Exchange. Being both buyer and seller, this costs the promoter nothing except the commissions of the brokers, who are glad to make a few dollars. The purpose of these fictitious transactions is to help the salesmen wherever they may be—in New England, in Pennsylvania, in Indiana, in Washington, D. C., or New York City itself. Imagine saying to a hesitant prospect, "See, these shares have gone from $1.05 up to $1.40 since I visited you ten days ago and they are going right along up to $5. Why don't you get in now. Every day you wait makes your profit just that much less." Nothing will stimulate a reluctant buyer more than seeing the forecast of the salesman coming true; and he does not know that the sales on which the quotations are made mean exactly nothing at all. Of course some stocks climb steadily for considerable periods from causes other than manipulation; but a uniform advance in the price of a speculative mine stock is generally credited in Wall Street to be the work of "market riggers" and "share pushers."

Bursting of the Bubble

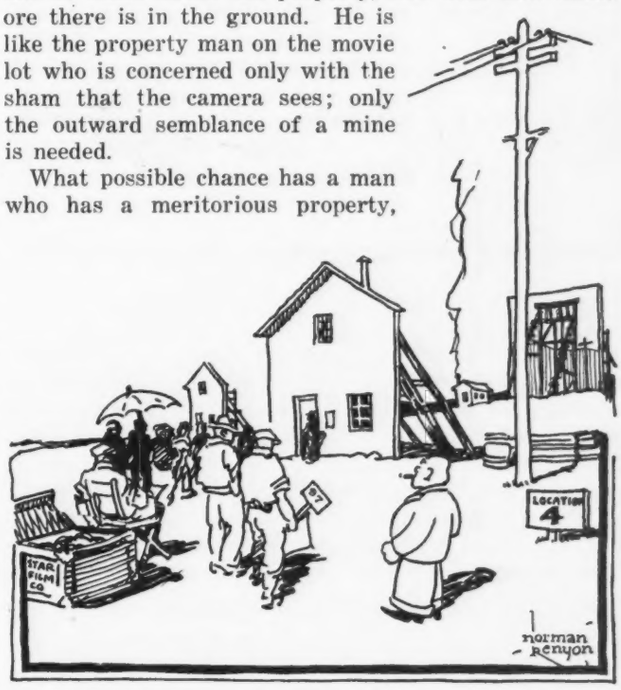
Of course the time will come when some of the purchasers decide that the quotation is high enough, and that they will take a profit and get out. As soon as this movement acquires volume the bubble is ready to burst, for it is no part of the plan of the promoter to buy back shares in any great quantity, and no one else wants them after the tide has turned. Thereupon the bottom drops out of the market and the shares dwindle to a few cents, where they really belong, since there exist 5,000,000 against an option on an average prospect. Finally there is no market and the stock soon disappears from the list.

Sometimes a broker himself will take an option on a block of shares at a few cents and proceed to "make" a market. That is, he undertakes to create enough activity, or apparent activity, to make it worth while to allow the stock to be listed. By means of deceptive newspaper notices, mail circularization, market letters, and other publicity measures he hopes to draw in enough of the public's money to make a profitable campaign.

He washes sales and slowly increases the price, playing on the proclivity of the "outside" speculator to take the bullish side of the market and buy for further rises while the price is upward bound. As in the case previously explained, such a campaign, even if successful, must finally end. Just before the break the broker may sell "short," thereby making another profit from the crash.

I have not gone into all the details of these manipulations, but have attempted to show the general scheme. The point is that the actual intrinsic value of the mining property involved is an incidental consideration. True, there must be something tangible on which to place the "window dressing," but the fraudulent promoter is concerned only with how good a sales talk can be made about the property, not with how much ore there is in the ground. He is like the property man on the movie lot who is concerned only with the sham that the camera sees; only the outward semblance of a mine is needed.

What possible chance has a man who has a meritorious property, reasonably capitalized, to get money in competition with these sharks? What chance has a man whose decency compels him to tell the truth about a property that he considers a fair speculation, against an unscupulous salesman who would talk of $19,500,000 a year net profit from the identical property, if he got it in his clutches?



"Only the outward semblance of a mine is needed"

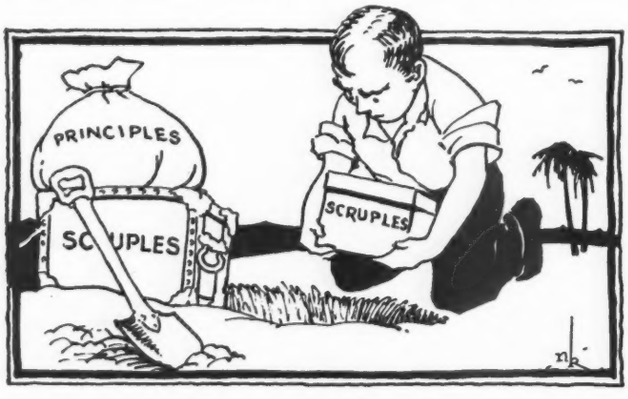
This question may be asked: Why not enlist the services of the man who is able to sell shares in anything, in behalf of the legitimate enterprise? Let him exaggerate and misrepresent: his customer is better off buying shares in a company that really has a chance than in one that is hopeless, regardless of the method that is used to get him to buy. The answer is easy. The disreputable promoter and his high-voltage salesmen are out for big money; they

will not pay more than a few cents for shares that they plan to market for a dollar, for the simple reason that they do not need to. And so long as tainted stocks can be sold easily and with impunity, they can get endless quantities of them for from 2c. to 10c. per share.

This brings up another fair question: What is meant by a legitimate mining speculation and what is the difference between such a speculation and a fraud? The essential distinction is this: Expectation of profit, in the first place, is based on exploitation of an ore deposit; in the second, on the exploitation of purchasers of shares. If you can determine this point, you can almost invariably be sure as to the character of any stock-selling enterprise.

Honesty of Financing a Vital Factor

A given piece of mining property may be made the basis of either an honest or a fraudulent stock flotation. The soundness of the financial arrangements and the integrity of the officials and the management are important elements. To illustrate, take Jim Smith's partly developed prospect. He could capitalize for $200,000; take 110,000 shares for the property and promotion services; allow a stock salesman 20c. each for selling $1 treasury shares without misrepresenting the facts; and spend $72,000 for the further opening of the property. Even if he failed to find enough ore to make an initial shipment, his project would have been legitimate. His shareholders—and in spite of the difficulties of selling such shares today it may be assumed that he had marketed 90,000 at $1—would have had an honest speculation. They would have had no just complaint whatever.



Even this is unlikely to help much

But suppose that after spending his $72,000 Jim had gone east, and had traded the 110,000 shares that he still owned for 2,500,100 shares in a company, with a capital of $5,000,000, newly organized for the purpose of taking over the property. Smith's shares would be tied up in escrow and the promoter would launch a selling campaign such as has been described. If the stockholders in Smith's original company had an even chance, the purchaser of shares in the new company would have, theoretically, about 1 chance in 45 if all the stock were issued; and the promoter would see to that.

Actually, however, the odds against him would be infinitely worse, for the reason that very little money would ever find its way into the development of the property. Even if ore were found and shipped, the chances would be remote indeed that dividends on the huge capitalization ever could be paid. The purpose and the expectation of the promoter who organized the company was not to make a profit by mining but by selling the shares.

And the Public Comes Back for More

It should be clear that, even if he buries his scruples and overcomes his natural tendency toward fair dealing, the small mine owner who wants to finance the further development of his property can accomplish little in that direction by dealing with the only man who can, under present conditions, really get money from the public. My contention is that money is to be had. The mere fact that millions are continually flowing into the coffers of the unscrupulous mining-stock salesman proves it. The situation is incongruous. The public gobbles up the fraudulent stuff, finds itself swindled, condemns all mining shares as being fakes, shuns the legitimate mining offerings like a pestilence, and then turns around and continues to buy into the rankest kind of mining frauds.

What, if anything, can be done about it—still forgetting the public and its losses, and considering the man who wants to raise money to dig in search of ore? If a practicable way were found to separate the manifest swindles from the honest speculations or to place an indelible brand upon the former, would the latter have a better chance to get money that is needed for the development of the mining industry?

Much of the speculative money might be diverted into other fields, for mining is by no means the only industry for which money is raised by disreputable methods. Of sixteen injunctions recently obtained under the Martin fraud law, by the Attorney General of New York State, restraining brokerage concerns and stock promoters from selling certain "securities" in the state, only three involved mining company shares. It cannot be argued that the elimination of crooked mining flotations would automatically divert speculative money into the honest mine enterprise, because there are many other outlets for this money. It is to be presumed, however, that the road simultaneously would be made rough for dishonest stock-selling schemes of all other kinds, and the competition accordingly would be lessened. In any event distinct benefit to legitimate mine finance ought to result.

Mining shares are in disrepute; probably they are looked upon with more suspicion today than ever before, largely on account of the many notorious swindles that have been perpetrated in recent years. Only gross misrepresentation gets the money. We have a vicious circle. And yet mining, digging for riches in old mother earth, offers certain unique attractions to the speculative instinct in every one, and if he has reason to believe that he is going to have a square deal he is likely to look with increased favor on the purchase of mining shares. The question then is, how to keep the fraudulent stock offerings off the market.

As has been pointed out, dealing on the stock exchanges is an important factor in the marketing of mining shares; and if the exchanges desired, they could do much toward making thorny the path of the promoter who desired to float a fraudulent stock issue, simply by excluding it from trading. The New York Stock Exchange, with few exceptions, does not accept for listing share-issues in embryonic enterprises; not

only are the requirements strict but they are rigidly observed, and unlisted stocks are excluded entirely. This is not the case on most other exchanges. It is desirable, of course, that some place be provided where stocks issued against properties still in the development stage may be dealt in, and the New York Curb and other smaller exchanges, especially in San Francisco and Boston, have a useful function in providing such a place—if they will perform that function legitimately. For the most part, however, they use little or no discrimination in granting the privilege of listing. Frequently the most important question asked of the applicant for listing is "How much money have you to make a market for the stock?" The broker who sponsors the stock must be prepared to guarantee a sufficient number of transactions, either bona fide or washed, to give the stock the appearance of activity. As the prosperity of the brokers who make the exchange depends on the volume of business, it is perhaps too much to expect them to exclude issues that promise active trading, just because the enterprise or the financing behind the stock is unsound.

Curb Listing Requirements Not Enforced

At any rate they do not do it. The published listing requirements of the New York Curb Market are fairly complete in many respects. One requirement respecting the possibilities of the property as a mine is No. 2, reading "Engineer's report as at a recent date or a certified copy thereof." However, an "engineer's report" is one of the easiest things to obtain, and may be as meaningless and as harmless as a report of an ice cream social. The character and scope of the report and the reputation of the engineer for integrity and competence are all-important. No. 16 reads "Statement giving amount of outstanding shares distributed and in the hands of the public, which must be at least 15 per cent, exclusive of officers, managers, directors, syndicate managers or agents." This is designed to show that enough stock is held by the public to assure active trading. Details of stock authorized, outstanding, and unissued are asked for, as well as copies of agreements involving shares pooled or deposited in escrow.

If every applicant for listing were held rigidly to requirements as prescribed, and if the information supplied were weighed carefully and intelligently by the governors with a view to refusing listing if a good case were not established, it is safe to say that a great many of the stocks now listed on the New York Curb would be excluded.

If the engineer's report, for example, is supplied as a mere formality, if it is not analyzed to see what, if anything, it means, it might just as well not be required. And if the clause providing for the distribution of 15 per cent of the stock to the public is a mere sham it adds nothing to the requirements. The making of a certificate for any number of shares in favor of the promoter's stenographer, who immediately indorses it back, is an easy and frequent method of fulfilling this requirement.

One of the worst features of the New York Curb is the trading in many unlisted mining stocks, about which the officials of the exchange admit they know practically nothing. Upon the very best authority it can be said that many Curb brokers, with the connivance of those who administer the affairs of the Exchange, co-operate with unscrupulous promoters to mislead and deceive the speculating public. The same thing is true to a greater or less extent in many of the other exchanges in the country where mining shares are dealt in.

Is the Answer "Blue-sky"?

But even if a thoroughgoing reform should take place in the stock exchanges—and that seems unlikely—there would still be the personal-solicitation method of selling worthless stocks, and the elimination of them would be little nearer realization than before. The question remains, what practicable step seems to promise most toward separating the legitimate sheep from the illegitimate goats. And the inescapable answer seems to be the "blue-sky" law. In a sense this statement is waving a red flag before the small mine operators. Many of them believe sincerely that any law that undertakes to restrict the freedom to sell stock, wherever and however the vendor can, is "obstructing development of natural resources," and "destroying the mining industry." To them I hasten to say that there are grave objections to many of the laws on the statute books today. But what other way is to be found to drive the faker out of business than by enacting and enforcing the right kind of a securities act? In general there are two kinds of "blue-sky" laws: (1) Wherein a commission or commissioner exercises personal judgment, in varying degree, as to whether a permit shall be issued for the sale of a specified block of shares, and (2) wherein compliance with certain specific, clearly stated requirements, principally the filing under oath of detailed information, automatically authorizes the vending of shares.

Danger in "Blue-sky" Laws of One Type

There is not space in this article to go deeply into the details of "blue-sky" laws. Briefly, the chief objection to laws of the first class—aside from the fact that grave possibility exists that some of them may be declared unconstitutional when tested in the courts—is the delegation of arbitrary authority to condemn a project on the basis of individual opinion as to the value of the property, the soundness of its financing, or the integrity and competence of those in charge of it or promoting it. It is argued, not without reason, that no man or set of men, especially political appointees, is qualified temperamentally to exercise such authority. The temptation for graft and extortion is too great.

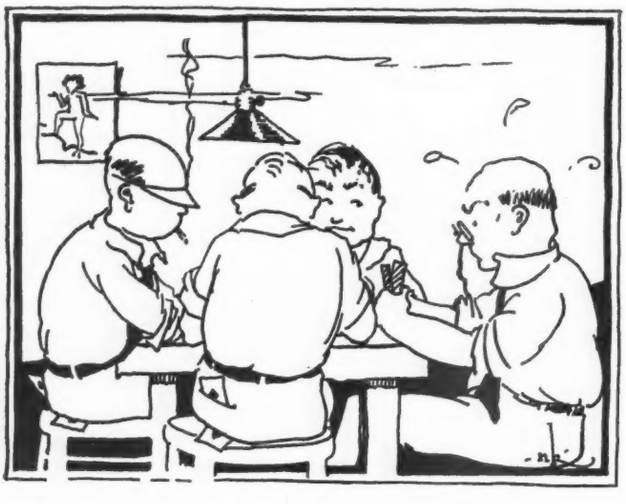
One of the most stringent laws is that of the State of Michigan. It provides that the commission "may make or have made under its direction a detailed examination of such investment company's property, business and affairs, which examination will be at the expense of such investment company. It may cause an appraisal to be made, at the expense of said investment company, of the property of the said investment company, including the value of patents, good will, promotion, and intangible assets, and it may fix the amount of stocks, bonds, and securities that shall be issued by any corporation, foreign or domestic, in payment for property, patents, good will, promotion, and intangible assets at the value it shall find the same to be worth. . . ." The rest of the law is no less severe. Unless the commission is satisfied that the purchaser will not be defrauded it shall not issue a permit to sell stock. This is an example of a law of the first class; it is not difficult to see how such a law might work a hardship

on a small mining company that desired to market its shares, particularly in view of the fact that a separate similar examination is required for each state having such a law. I do not advocate the passage of a statute of this kind.

Make the Promoter Lay His Cards on the Table

There does, however, seem to be great hope in a stringent law of the second type. The theory of such a law is to compel the corporation issuing the shares to put its cards on the table in plain sight, so that the prospective player (the purchaser) can see just what kind of a game he is going to sit in. If he does not know enough to perceive the fact that the odds are all against him, or at least if he lacks enough horse sense to stay out of something that he does not understand, he deserves to be swindled. This is perhaps a cold-blooded way to put the case, but that is what laws of this type amount to. Of course, it is expected that many of the crooks will voluntarily cease activity if they are forced to make a clean breast of their propositions.

The issuer, who is presumably the vendor of the shares, is compelled to file sworn statements setting forth every essential fact with respect to the affairs of the company. Each officer and every member of the board of directors, personally, is a signatory to these statements, which become a public record. The act of filing automatically authorizes selling or attempted selling of the securities. It is, however, a criminal offence, punishable by heavy fine and a stiff jail sentence, if any of the statements are false or misleading to a material extent. Officers and directors will be very careful in signing reports when they are under oath and the document is to become a public record. In the Colorado law, which is drawn after this general plan, the salient facts must be presented in the form of a prospectus, verified copies of which can be obtained by any



Better stay out of a game with strangers; they are too "lucky"

one on application to the Secretary of State, who is the administrative officer under the act. A new prospectus must be prepared each six months if efforts to sell shares are continued.

Obviously, it is necessary, in order to avoid undue hardship, to exclude numerous classes of securities from the provisions of this act. Non-speculative issues of various kinds, bonds secured by mortgages on farm lands, and stocks of long-established companies are among these. A remarkable feature of the Colorado law is the exclusion of securities issued by a concern whose securities have been listed regularly on the New York, Boston, and Chicago stock exchanges and on the New York Curb! The implication that the New York Curb gives any stock a clean bill of health has doubtless afforded the members of that organization many a hearty laugh—in private of course.

Swear to the Facts

The information required in the sworn statements varies in different laws. The following is an abridged list shorn of legal verbiage:

1. Detailed corporate history of the company and its direct predecessors, including particulars of capitalization and the exact ownership of the outstanding stock.
2. Description of all securities sold for cash, with a record of brokerage or commissions paid and the net proceeds turned into the treasury of the company.
3. Description and amount of securities issued or proposed to be issued as fully paid for any consideration other than cash.
4. Complete details regarding any option, contract, pool, syndicate or escrow agreements involving shares.
5. Details of plan proposed for marketing treasury shares, including commissions to be allowed and a statement of the amount actually realized by the treasury on sales up to date.
6. Names, addresses, references, and salaries of all officers, directors and managers.
7. Description of property involved, with complete record, with specific figures, of development done and proposed plan for future work. Description of plant and heavy equipment owned. If an engineer's report is referred to, the name, address, and professional connections of the engineer should be given.
8. Details of deeds, options, leases, or other instruments under which the property has been acquired or is proposed to be acquired, including money paid or other consideration involved.
9. Legal opinion and abstract as to the validity of the title under which property rights are claimed.
10. Financial report showing condensed statement of liabilities and assets and full trial balance as of the same date.
11. Detailed statement of income and disbursements and of development, plant improvement, and output for the six months preceding date of the report.

It would be important that a new statement giving the facts included under (11) and details of further sales of shares be required every six months if stock selling were to be continued. Such a statement in itself would afford a prospective purchaser of stock enough information to judge of the general character of the enterprise.

Laws similar to this are already on the statute books in England, in certain provinces in Canada and in some states. No inherent obstacle exists to prevent the passage of similar laws in the other states; indeed, many authorities agree that the question of the regulation of the sale of speculative securities is of such broad scope that a federal law regarding it would be held constitutional.

Suppose that such a law were in effect. Just what would be the probable result; how would the law operate in a practical way to make it more easy for the owner of the embryonic mine to finance further work?

Naturally, there is more or less guesswork in the answer. In the first place, no law is going to change human nature. The desire to get rich quick will be no less strong, and people will still part with their money if they think they will get it back many fold. How-

ever, it seems certain that the average purchaser of speculative stocks is not so ignorant as he is generally credited to be. The people who supply most of the money to the unscrupulous stock salesmen today are the kind we class as well-to-do. In everything but their stock gambling they have more than the average intelligence. The first rule of the salesman is to go where the money is. Newspaper advertising and mail circularization soliciting subscriptions to be sent by mail often get "money-order" cash from poor people, but the bulk of the money comes from those who are moderately well off.

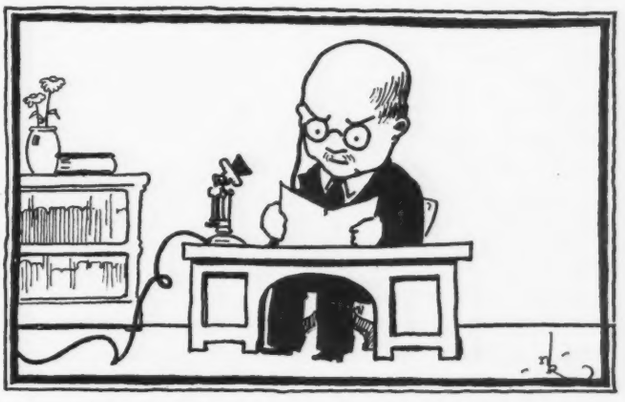
Will the Average Investor Protect Himself?

Now, if it were known to everyone that for a nominal sum, say $1, some state or federal official would mail a certified copy of the sworn statements of the officials of the company concerning the enterprise, would the average man spend the dollar before he would write his check for $100 or $10,000 as the case might be? I think he would. Would the average man sitting in the privacy of his office, away from the influence of a spell-binding salesman, have sense enough to discriminate between (1) a venture that offered him a chance to share a legitimate speculation with honest men who wanted to develop a potential mining property, and (2) a stock-selling scheme in which the disreputable promoters or stock brokers operated to line their own pockets, and used a few mining claims as a convenient dummy against which to issue the stock? Again I think he would.

The time would come when the "pickings" of the grafter would be so "slim" that his numbers would shrivel for lack of nourishment. Then the honest, decent promoter would have a chance. People would still hanker for a speculation and the man with a reasonably promising prospect, fairly capitalized and properly managed, would get the money he needed. Perhaps I am overly optimistic; at any rate, I can see no practicable alternative that offers so good a chance for accomplishing the purpose as the one that I have here outlined.

Making the Gamble Fair

In conclusion I want to make this clear: I do not mean for a minute to suggest that if the out-and-out frauds are eliminated every speculator in mining shares will make a profit; nor do I imply that all failures are



"Away from the influence of the spell-binding salesman"

the result of dishonest promotions. Every business venture of every kind is subject to hazard, and mining has in addition a unique risk that is absent in most other kinds of business. Speculators may continue to lose their money more frequently than they win, but they will have the satisfaction of knowing that a fair proportion of the money they supply is going into the eternal gamble with Nature, as to the disposition she has made of the mineral riches in the crust of the earth, instead of being pocketed by a band of sure-thing brokers and promoters whose last thought in the world is the development of mines.

United States Magnesite Production Shows Big Increase in 1923

Statistics compiled by J. M. Hill, of the U. S. Geological Survey, show that the magnesite material marketed in the United States in 1923 from domestic mines was equivalent to 147,250 short tons of crude magnesite, valued at $1,103,700, an increase of 164 per cent in quantity and 93 per cent in value compared with 1922. As the value is based on the price of crude magnesite f.o.b. mines, and as about 50 per cent of the output—a much larger percentage than usual—was made in the State of Washington, where the operators place a low value on the crude uncalcined rock, the increase in value in 1923 was low when compared with the increase in quantity.

Eight producers of magnesite in California in 1923 were operating at eleven localities in Napa, San Benito, Santa Clara, Stanislaus, Tulare, and Tuolumne counties. In Washington the output came from three properties which are situated near Valley and Chewelah, in Stevens County.

The reports of the Bureau of Foreign and Domestic Commerce show that the magnesite material imported for domestic consumption in 1923 amounted to 5,182 short tons of crude magnesite, valued at $44,081; 10,928 tons of caustic calcined magnesite, value at $306,610; and 61,726 tons of dead-burned magnesite, valued at $707,383. These figures appear to indicate that the foreign producers can mine and calcine magnesite more cheaply than the domestic producers. No crude or calcined magnesite was exported from the United States in the year under review.

Magnesite (Expressed as Crude) Consumed in the United States in 1918-1823

In Short Tons

Year	Domestic Production	Imports	Apparent Total Consumption	Proportion of Consumption Supplied by Domestic	Foreign
1918	231,605	43,530	275,135	84	16
1919	156,226	25,321	181,547	86	14
1920	303,767	63,110	366,877	83	17
1921	47,904	65,569	113,473	42	58
1922	55,790	217,861	273,651	26	74
1923	147,250	150,490	340,829	43	57

The table shows that the domestic producers regained in 1923 some of the market they lost in 1922, largely, probably, because of the protection afforded by the new tariff act. Operators report, however, that even with the present tariff it is almost impossible to compete with either dead-burned or caustic foreign magnesite in the eastern markets, on account of the great cost of production and high freight rates.

Ore Injection at Edwards, New York

A Study of the Sequence of Magmatic Events in This Zinc-Producing District

By J. E. Spurr

THE EDWARDS ZINC MINE, in St. Lawrence County, in the northern border of New York State, is of considerable economic importance, having produced some 12,000,000 lb. of zinc annually since 1915. The geology has been described by D. H. Newland[1] and C. H. Smyth, Jr.[2] and briefly by W. R. Wade and Alfred Wandke.[3] During a brief visit to the property in November, 1923, under the guidance of manager Wade and his staff, I was enabled to inspect some of the main features. After having the advantage of studying carefully the work of the geologists who preceded me, and who devoted much more study to the problem than I did, and after comparing the observations I myself made, I think it worth while to present a picture of the geological problem, in so far as it appears clear to me.

The rocks of the region are all pre-Cambrian. The country rock of the ores is crystalline dolomite, intercalated with gneiss layers. These intercalated dolomites and gneisses are surrounded and presumably underlain by thicker gneisses. The gneisses and dolomites belong to the Grenville series, which Miller and Knight[4] believe to overlie the Keewatin, and to underlie the Huronian. The gneisses which I saw at and near the mine seemed to me to be clearly altered quartzites, originally more or less impure, and mixed with arkose or silt material. In other words, the interbedded dolomite and gneiss represent an original sedimentary series of alternating limestone (or dolomites) and quartzites. This origin of the gneiss is substantially that held by Newland and others.

The dolomite in which the orebodies lie is part of a dolomite area about eight miles long in a northeast and southwest direction, and shaped much like the horizontal longitudinal section of a dirigible airship. The width is one and a half miles or less. This area is surrounded by gneiss, with, according to the literature, some granite and other igneous rocks, all intrusive into the gneiss. These intrusives are of Algoman age, according to Newland. A cross-section of the belt shows a similar dip throughout, of about 45 deg. to the northwest. Nevertheless, the dirigible-shaped exposure, and the reported fact that the dolomite dips in, away from the gneiss, at both ends of the dolomite area, and the fact that geologic maps show other dolomite areas of similar shape though somewhat different size in the gneiss, suggest that the dolomite body in question is confined in a syncline, or canoe-shaped fold, except that the canoe, to expand the metaphor, is careened to one side. Add to that the evidence that the dolomite goes deep, since the dip of the two sides is parallel for some

[1] N. Y. State Defence Council Bull. No. 1, 1917: "The Zinc-Pyrite Deposit of the Edwards District, N. Y."
[2] N. Y. State Museum Bull. No. 201, 1917: "Genesis of the Zinc Ores of the Edwards District, N. Y."
[3] *E. & M. J.-P.*, July 21, 1923, p. 95.
[4] 16th Ann. Rep. Ont. Bureau of Mines, 1907, Part I, pp. 203-223.

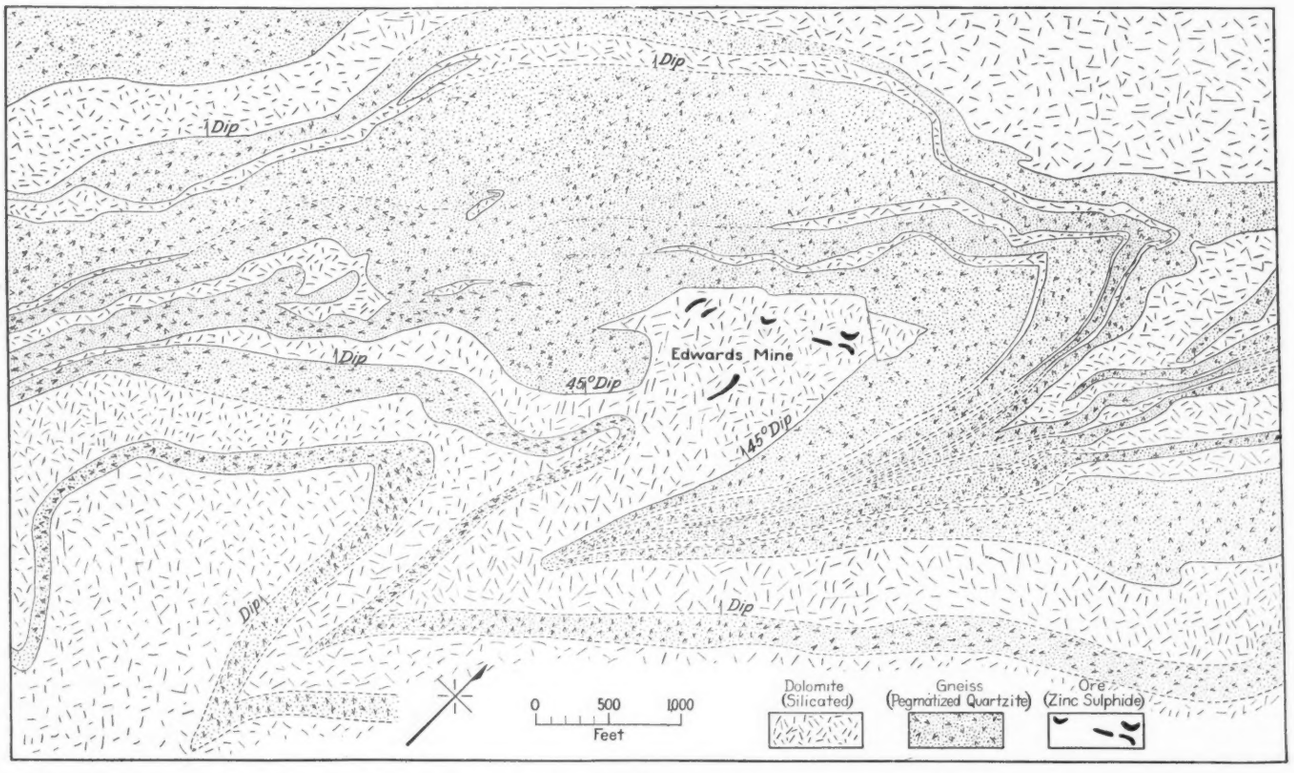


Fig. 1—Survey of surface in the general vicinity of Edwards mine, showing folding of pegmatized quartzite and dolomite. By the engineering staff at the Edwards mine

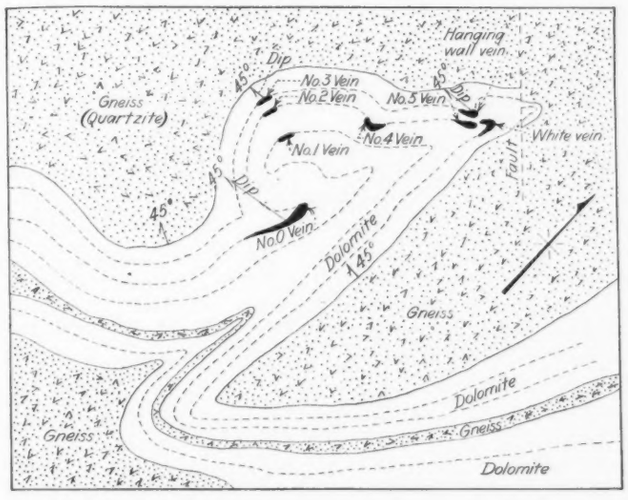


Fig. 2—Geological map of 800-ft. level, Edwards mine. Adapted slightly from map by Wade and Wandke, E. & M. J.-P., July 21, 1923, p. 96

distance down, at least where explored, and we have the additional picture, not of a typical canoe cross-section, but one more like that of a transatlantic liner, or even much deeper—the fold was evidently much compressed.

The outline of the fold, as shown by the surrounding gneiss, is not as regular as above stated; indeed, it is irregular, bulging out into bays, and thus testifying to the powerful and not too simple nature of the folding stress. See Fig. 1. In such a bay or minor auxiliary fold near the extreme northeastern end of the main dolomite belt lie the ore deposits of the Edwards district, consisting of several distinct oreshoots, all within an area about 1,200 ft. long by 600 ft. wide. See Fig. 2.

Orebodies Associated With Curves in Strata

The orebodies, which are essentially bodies of zinc-blende, pitch with the bedding 45 deg. to the west, and are usually continuous for hundreds of feet directly down the dip. They have a relatively short horizontal extent along the strike of the dolomite, as compared with their extent up and down; and their thickness is still less. They partake, then, in a horizontal section, something of the nature of short and soon-terminated veins; but also something of the nature of a chimney; and this general figure of a chimney is heightened by the very long vertical cross-section. This vertical cross-section is more uniform than the horizontal section, though by no means regular. The horizontal section, however, is typically curved and often sharply so. See Fig. 3. Indeed, the orebodies seem to be peculiar to sharp small curves in the strata—sudden local turnings or bendings which mar the larger foldings; and, conversely, they have not been found along the straight horizontal stretches of folded strata. "No curve, no ore," the manager, Mr. Wade, expressed it to me. This circumstance, and the fact that the ores have been practically undisturbed by movement, since their deposition, show that the curved horizontal section does not mean that the orebody has been folded, but that the folding all preceded the ore; and that these sharp curves have been chosen preferentially as pathways for ore solutions. And when this is clear, it is further clear that these sharp bendings have created chimney-like channels of maximum openness, or minimum rock pressure, so that for this reason the ore solutions found their way along them.

Picture lengths of zinc roof-gutter, all tilted at an angle of 45 deg., and you get a rough conception of these orebodies—especially if you picture the zinc gutter beaten and pinched out of shape in the horizontal section.

The ores have been followed from the surface to a vertical depth of over a thousand feet, or to a depth on the dip of nearly 1,500 ft., without change of character; hence the general belief of geologists, in which I share, that the ore solutions rose from below along these channels.

One of the most critical points in my story is this: The quartzite which is interbedded with the dolomite (Fig. 1) appears gneissic, and with good reason is called a gneiss, mainly because of a wonderfully complete penetration of the quartzite by pegmatitic material. This is crystallized in little seams and crosscutting dikelets of pink pegmatite, of all sizes, with some white pegmatitic quartz; and in some places there are larger concentrations and bodies of this pegmatitic material. Also, the pegmatitic material penetrated the whole rock intimately, so that very little of the quartzite is free from its presence; it is "shot all through it," to use a miner's expression. This has been recognized also by Newland[5]:

> "The sedimentary gneisses in the Edwards district have undergone further transformation by admixture with magmatic materials, particularly granite. In nearly every exposure they may be seen to be cut by dikes or veined and banded by a network of intersecting stringers of granite and pegmatite, which stand out in strong contrast by their fresher appearance and usually bright pink or red color. The proportion of this injected matter is extremely variable, ranging on the one side from an occasional stringer insignificant in mass, to a condition of thorough injection in which the igneous element may overbalance the sedimentary base. Along with the injection, which in extreme cases results in a mosaic pattern of the two materials, has occurred a greater or less diffusion of the magmatic ingredients all through the body of the sedimentary gneiss, as if the latter had been drenched, so to speak, in the liquid magma."

This pegmatitic material contains some feldspar, much quartz, biotite, not infrequently tourmaline, and

[5]*Op. cit*, p. 29.

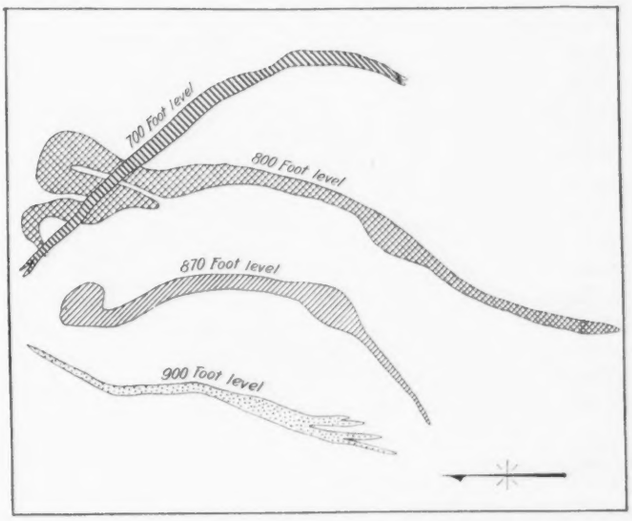


Fig. 3—Plan of the O orebody, Edwards mine, on 700, 800, 870, and 900-ft. levels

so on; the usual texture is not very coarse, but is medium-grained to very moderately coarse: hence not only the term "pegmatite" but the term "granite" is used by Newland in the quotation above. But his description shows clearly a highly penetrant and therefore aqueous magma—more penetrant than the usual pegmatite magma; and corresponding with what I have called a superpegmatitic magma.[6] Professor Colony has described also this extremely fluid and penetrant type of granite magma solution in the pre-Cambrian rocks in the vicinity of New York.[7]

Now, I wish to emphasize this point yet again, so as to stress a corollary: this superpegmatitic granitic

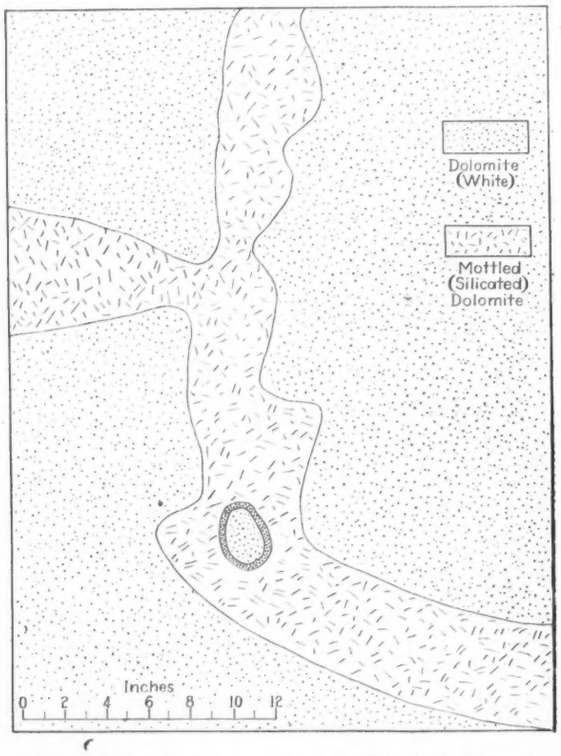


Fig. 4—Sketch showing vein of silicated dolomite in white dolomite, Edwards mine. Note heavy dark contact rim around inclusion of white dolomite in vein

surge penetrated the quartzite near the mine wherever the quartzite is found—beds intercalated with limestone as well as thicker beds underlying it; it is now found penetrating the quartzites thoroughly and throughout, right up to the contacts of the dolomite. Evidently, then, it was a general flood, sent up from some great mass of relatively drier granitic magma below. *Evidently, moreover, this universal surge must have drenched the dolomite beds also.* They could not possibly have escaped the general penetration. But there are no pegmatitic intrusions, seams, or intercalations in the dolomite. Proven, then, that the superpegmatitic magma mingled with the dolomite and combined with it, losing its identity. That this as a rule happens to the true pegmatite magma when it enters limestone (or dolomite) I have before argued[8]:

"With limestone, the pegmatitic and superpegmatitic magmas combine to form lime silicates, and they tend to penetrate and to pegmatize less soluble rocks. Doubtless the most potent elements in accomplishing this are the gaseous elements; and in the extreme gaseous or superpegmatitic phase, we may believe that the penetrant power of the magma becomes very great."

And, to be sure, we find the intercalated dolomite altered to lime-magnesia silicates: principally, according to the geologists I have cited, diopside, with some tremolite and phlogopite. Diopside is one of the pyroxenes, and a lime-magnesia silicate; tremolite, which occurs sparingly near the mines, is one of the hornblendes, and is a magnesia-lime silicate. Phlogopite, which is not so common, is a dark mica containing principally silica, magnesia, alumina, and potash, with 1 to 4 per cent of fluorine, eloquent of the gaseous content of the superpegmatitic magma which was responsible for these silicates.

Typically, the introduced silicates occur in isolated crystals or little groups of crystals, as I observed in the mines—crystals of moderate dimensions, about the size of phenocrysts in the ordinary igneous porphyry; they have sprung up throughout the crystalline dolomite like phenocrysts, so that the altered rock—not so much metamorphosed at metasomatosed—has very much the appearance of an igneous rock, whether like porphyry or (if the seeming phenocrysts crowd closely together) like a fine-grained granite or gneiss. This curious internal structure is typical and practically universal. It is a type of replacement brought about by the new mineral appearing in the heart of the rock, coming from nowhere apparently; as I have described for the quartz crystals in the early stages of the silicification of the dolomite at Aspen, in Colorado.[9] And this strengthens anew my belief that the appearance of isolated crystals in a rock, inclosed by crystals of another mineral, does not necessarily prove that the inclosed mineral is older; and my belief that solutions can pass through solid rocks without a visible channel, and in them crystallize here and there, spotwise, replacing the early minerals just enough to make room for the new perfect and unhampered crystals.[10]

The dolomite is not entirely or evenly altered to this diopside-dolomite rock. Certain limited portions are thus altered little or not at all, and remain pure or nearly pure dolomite; and the altered portion is altered to various degrees, but always, where I observed it, retaining this peculiar spotted structure. The pegmatitic fluid, indeed, penetrated best along certain channels and had an irregular distribution in the dolomite, just as it did, more patently, in the interbedded quartzite. The trace of one such channel is shown in Fig. 4, which I sketched. Nevertheless, the partial replacement by diopside is widespread, characterizing practically all of the rock in the mine, whether near or far from the orebodies, just as the pegmatization of the quartzite is widespread.

In the drenching of the dolomite by the "metamorphosing" pegmatitic fluid, it is noted locally that certain layers of the dolomite were replaced sooner than others, leaving other layers unreplaced, or partly replaced, and thus isolating them into islands (Fig. 5). Where the dolomite has been much buckled and crushed, these more resistant layers have resulted in variously oriented residual fragments of white dolomite in the mottled background of lime-silicated dolomite (Fig. 6).

[6]"The Ore Magmas," Vol. I, p. 328.
[7]*Journal of Geology*, Vol. XXXI, No. 3, p. 169 *et seq.*, Apr. 1, 1923.
[8]*Economic Geology*, Vol. VII, No. 5, p. 475. Also "The Ore Magmas," Vol. I, p. 325; also p. 261, 322.
[9]Monograph XXXI, U. S. Geol. Surv., p. 218.
[10]"The Ore Magmas," Vol. II, p. 563.

The silicates have formed more thickly in a band at the margin of these inclusions, producing a characteristic dark rim, especially where the silicates are serpentinized, as described later on.

The ore deposition consisted essentially of zinc-blende and pyrite. There is also a little galena—about 1 part lead to 230 parts zinc in the Edwards mine, although other prospects a few miles away have more lead. Other metallic minerals are negligible. There is little noticeable gangue: the deposition was practically a zinc-iron sulphide, and therefore this was the metallic composition of the ore magma (ore solution). The ore solutions, unlike the silicating solutions, had highly restricted channels. There is plenty of evidence that the sulphides replaced the older dolomite and the older lime silicates, such as pyroxene and tremolite. Smyth has demonstrated this by microscopic study; and it is evident in the mines. The blende and pyrite crystals appear spotwise in the older rock (silicated dolomite), just as the pyroxene did in the earlier stage in the dolomite. But the sulphide crystals also cluster together thickly, till the original rock only fills the interstices between them; and finally they coalesce into practically a solid sulphide mass. The solid ores often have a clean-cut boundary against the wall rock[11] (Fig. 7), showing sharply restricted channels of the ore solutions—showing also that although the sulphides have formed partly at least by replacement, their concentration into certain channels (instead of spreading out thinly through the country rock, as did the solutions of the pegmatitic stage) indicates a denser, less gaseous-aqueous, and more concentrated magma solution than that of the pegmatite.

One other widespread phenomenon requires notice—the presence of serpentine throughout the rocks. This occurs quite indiscriminately, so far as I could judge, near and remote from the orebodies: it does not, therefore, seem to have been derived from the ore-magma solutions, but to have been derived from solutions having the same wide range of passage as the pegmatitic silicating solutions. Yet this hydrous silicate (serpentine) was distinctly younger than the diopside and tremolite, which have been replaced by it: indeed, it is an alteration product of these silicates. The diopside crystals which pepper the dolomite rock in the mine have altered to a greenish aggregate which is principally serpentine, as kindly determined for me microscopically by Professor J. Volney Lewis. The included fragments of white unsilicated dolomite in the silicate rock (mentioned above) have typically a rim of green serpentine, due partly to a massing of the original silicates on the borders of the fragments and partly to a spread of the later serpentinization from this band toward the interior of the inclusion, the serpentine forming directly at the expense of the dolomite (Figs. 6 and 7); and this rim is seen to widen, in the case of different fragments, till the whole fragment is changed to pale green serpentine— a process involving, of course, the addition of silica and water, and the abstraction of lime.

The widespread serpentine discussed above seems to me plainly earlier than the sulphide deposition: the sulphide ores clearly replace the older rock, serpentine and all. Indeed, the solid sulphide bands quite characteristically have on their borders a white bleached band, from which the serpentine has disappeared (Fig. 7).

[11]D. H. Newland: "The Zinc-Pyrite Deposits of the Edwards District, N. Y.," pp. 49, 50.

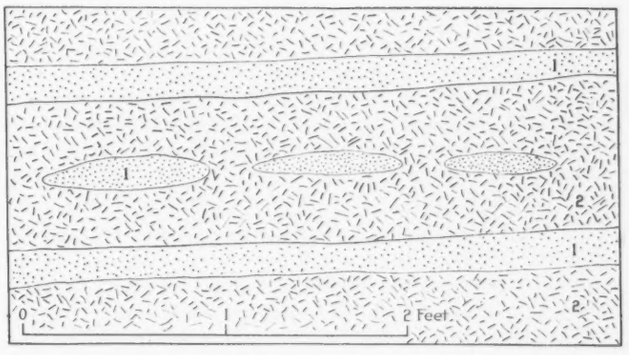


Fig. 5—Sketch in Edwards mine, showing incomplete replacement of unbroken dolomite by silicates

1, white dolomite; 2, dark mottled rock, dolomite thickly sprinkled with silicates which have been serpentinized.

Nevertheless, there is in the minds of those who have studied the ores microscopically much doubt as to the age of the serpentine (and of the talc, which appears in the mine as an alteration product also, of about the same age as the serpentine, or a little older). C. H. Smyth, Jr., has weighed the question carefully, on the basis of a study of specimens and thin sections, finding much evidence both for and against the conclusion that the serpentine was older than the metallic sulphides. But since he found a little serpentine veining these sulphides, he inclined finally to place the serpentine (and talc) as younger than the sulphides.[12] But this fact cannot, I think, cancel the field evidence recited above, and the relative special distribution of serpentine and sulphides. The fact of a little, principally microscopic, serpentine veining the blende is evident from Smyth's descriptions: with this is associated a little pale blende, younger, therefore, than the main "black-jack" of the ores, and unimportant quantitatively. At any rate the serpentinization, which was widespread, belonged to a period quite distinct from the highly localized metallization.

In general, and summing up, I agree with the geol-

[12]*Op. cit.*, p. 26.

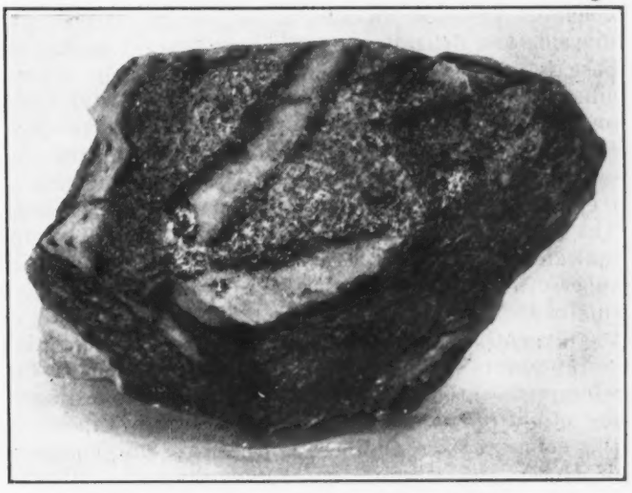


Fig. 6—This photograph shows the mottled lime-silicated rock, with residual white dolomite fragments. The lime-silicate rock has been altered to serpentine, which also marks the margins of the dolomite fragments. Photograph one-half natural size

ogists who have written concerning this occurrence, that the ores are of magmatic origin. The phenomena fit in well with this hypothesis, and do not fit in well with any other. The widespread pegmatization, which was a distinctly earlier event than the ore injection, is one of the most significant features supporting this belief; this pegmatization is clearly to be referred to underlying granite magma, whose offshots outcrop, not very near the mine, but here and there at various distances away. This granite (and pegmatite) intrusion is referred by Newland to the Algoman (pre-Cambrian) period of Canadian geologists.[13]

The pegmatization of the quartzites and the lime-silication of the dolomites were, according to the conclusion presented above, both produced by the same pegmatitic to superpegmatitic gaseous (aqueous) granitic magma; and therefore were formed at the same temperature, which we may roughly place at about 550 deg. C., according to experiments made as to

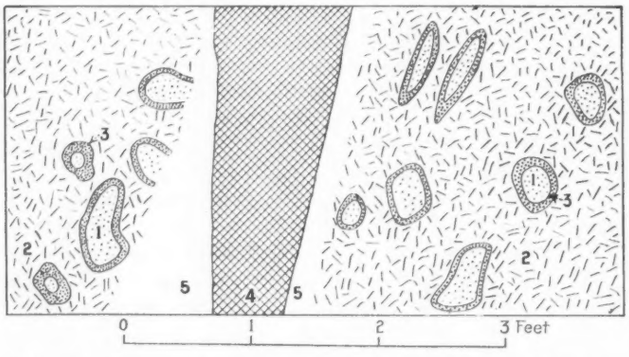


Fig. 7—Sketch of vein of solid blende (No. 4 vein) on 1,300-ft. level, showing successive magmatic events

1, residual fragments of unreplaced white dolomite in: (2) mottled silicated dolomite, due to injection of fluid siliceous (superpegmatitic) magma at high temperature. Silicates (chiefly diopside and tremolite) have been mainly altered to serpentine, which has also attacked the margins of residual dolomite fragments (3). Later than all the above is solid blende (4), which has bleached the altered dolomite wall rock near the contacts (5).

the temperature of formation of pyroxenes, and of the quartz of pegmatites.[14]

The later formation of serpentine, partly at the expense of pyroxene and partly by replacement of dolomite, involved an abstraction of lime from both diopside and dolomite, and the hydration of both. No base is added in either case except probably a little silica: therefore the process is the result of water vapor and other vapors—not of any type of magma, properly speaking. This is also true of the recorded alteration of diopside to talc and the more common alteration of tremolite to talc;[15] all involve the same removal of lime. The uniform serpentinization at all depths in the mine indicates that this was the work of hot water or water vapors, rather than the result of atmospheric waters: and this is also shown by my observations as to the bulk of the serpentine being of earlier age than the sulphides, and therefore formed at a very considerable depth. The widespread serpentinization, indeed, points to a drenching of the whole rock with water or water vapor. In this connection we may note, in passing, the conclusion of Morey and Niggli[16] that "Many hydrated silicates have been obtained under conditions which point to their formation from solutions at temperatures above 400 deg., and therefore presumably from fluid (not liquid) solutions."

The ore magma was a subsequent, highly individual, highly localized injection, fluid enough to replace the limestone, but evidently, as above stated, not so fluid as the superpegmatitic magma which produced the pegmatization of the quartzite and the silication of the dolomite. Evidently, from all its associations, the blende-pyrite magma was a differentiate from the granite magma in depth; it evidently was, therefore, siliceous rather than calcic; and hence attacked the limestone and replaced it. As to the temperature of this zinc sulphide injection, I have surmised that all of the ore magmas proper are injected at above 365 deg., or the critical temperature of water.[17]

The presence of a little serpentine later than the ores, therefore, would indicate the slight overlapping of the general and widespread water-vapor drenching, past the sudden period of local sulphide injection.

As to the depth of ore formation, the exposure of pegmatites at the present surface indicates a depth of thousands of feet at the time of pegmatization, and although there was doubtless considerable erosion between this time and that of the ore injection, the known data indicate that zinc ore magmas may solidify at a depth of thousands of feet—say, for example, ten thousand feet.[18]

This zinc sulphide deposit, then, is not to have its nature defined by the lime silicates which occur in the dolomites which form the country rock of the ore: the lime silicates (pyroxene and some hornblende) are not only distinctly earlier than the sulphides, as Smyth has seen, but were formed at a different period. There is a great gap in the ideal magmatic sequence between these iron-free silicates and the blende, just as there is a gap in the ideal magmatic sequence after the blende. There were, simply, two sharply defined injections, fragments of the complete ideal sequence.

In this vicinity are considerable deposits of talc, from which, for many years, a large and steady production has been made. The talc, according to Smyth[19] and Newland,[20] is the result of alteration of tremolite, which occurs largely in extensive steeply dipping beds or veins. Tremolite, according to Wade and Wandke,[21] is rare or lacking in the Edwards mine; but Professor Lewis has observed it in the few specimens I sent him, both in the rock remote from the ore and in that mixed with it.

Diopside has been observed by the geologists I have cited above to alter to talc, but to a less degree than does tremolite; and this talc may in turn be altered to serpentine. The tremolite is held by Smyth and by Newland to occur in belts in the dolomite, rather nearer the contact of the gneiss than does the diopside, but this distinction appears to me not certain. Amphiboles (of which tremolite is a species) form at a somewhat lower temperature than pyroxenes[22] (of which diopside is a species): therefore it seems to me probable that the tremolite was formed from the same pegmatitic solutions or residual siliceous magma as the diopside, but slightly later; and that the concentration of the tremolite along certain beds or fissure-like extended openings depended on dynamic conditions at the time

[13] *Op. cit.*, p. 36.
[14] "The Ore Magmas," Vol. I, pp. 263, 319.
[15] C. H. Smyth, Jr., *Op. cit.*, pp. 16, 19.
[16] Am. *Jour. Ch. Soc.*, Vol. XXXV, No. 9, p. 1102.
[17] "The Ore Magmas," Vol. II, pp. 657, 796.
[18] "The Ore Magmas," Vol. I, pp. 293, 417.
[19] *Op. cit.*, p. 18.
[20] *Op. cit.*, p. 25.
[21] *E. & M. J.-P.*, Vol. 116, No. 3, p. 97.
[22] "The Ore Magmas," Vol. I, p. 80.

of the deposition of this silicate. The talc deposits (derived from the tremolite) and the metallic sulphide (principally blende) deposits are separate and distinct, even when they occur, as they sometimes do, near together; showing again the quite different periods of deposition of tremolite and sulphides, and the fact of a gap between the two periods, since there are no transition deposits between the talc deposits and the sulphide orebodies. Moreover, the widespread and all but universal transformation of the tremolite to talc, involving the addition of water and probably the action of carbon dioxide,[23] indicates a widespread and thorough drenching by aqueous material, which, as before stated, we may assume to have been water and carbon dioxide vapors given off in great volume from great expanses of cooling granite below—this water being not an ore magma, but residual excluded water vapor, corresponding with the coolest type of surface fumaroles,[24] and forming, by alteration of already existing silicates, the serpentine as well as the talc.

Another question which should be touched upon is the origin of the magnesia in the dolomite. The dolomite at the Edwards mine is a true dolomite;[25] yet Smyth by an apparent oversight refers to the carbonate throughout as "calcite." But though the carbonate here is practically all dolomite, the Grenville limestone is not all dolomite everywhere—not even all through the elongated island in one end of which the zinc deposits lie, some areas being of calcite limestone. As to the origin of these differences, Newland is in doubt. But it may be noted that in the Grenville limestone in Quebec G. W. Bain[26] finds that the relative local concentration of magnesia is not original, but is due to replacement of original limestone beds. Both dolomite and magnesite (the magnesite bodies are worked as commercial deposits) "occur only beneath impervious dikes and on the crest of anticlines or for a short distance down their flanks and plunge," indicating concentration by rising waters. Bain further concludes that "the magnesia-bearing waters seem to have been given off by a granite magma during its final stages of consolidation." At Aspen, in Colorado, I found that the zinc-lead silver deposition was accompanied by an addition of magnesia to the limestone, producing dolomite; and at Glenwood Springs, near by, I found evidence that hot sulphur springs, at a temperature of 130 deg. F., and carrying much magnesia in solution, are altering limestones along water channels, by the addition of magnesia and the corresponding extraction of lime.[27]

Theory as to Dolomization

If the magnesia at the Edwards mine has been introduced in the manner so well argued by G. W. Bain for the Quebec magnesite occurrences, the epoch of this concentration is not immediately clear. The widespread replacement of the Grenville "limestone" to lime-magnesia silicates by clearly pegmatitic and siliceous fluids indicates that the rock had become dolomite earlier than this period. Nor does the dolomite especially characterize, so far as known, the immediate vicinity of the orebodies, as it does at Aspen, and in the Joplin district, in Missouri[28] and neighboring states. In the Edwards district, therefore, if the dolomization has indeed been accomplished by ascending solutions, I should be inclined to believe that this action antedated the cycle of magmatic injections at Edwards, initiated by the intrusion of the neighboring unsheared granite. This granite has been held to be of Algoman age: earlier than this were Laurentian granite intrusions, now sheared. The hypothesis thus suggested, that the dolomization at Edwards may belong to the Laurentian cycle of magmatic phenomena, corresponds with the findings of G. W. Bain in Quebec, where there are displayed Laurentian granites, considerably foliated by pressure; these are cut by Algoman granite which has not undergone foliation. And Bain[29] concludes that "The deposits of magnesite and dolomite occur in the Grenville limestone and are intimately associated with the skarn rocks, biotite gneiss, and dikes of Laurentian or earlier age."

Had the Grenville "limestone," which at Edwards was penetrated by the Algoman siliceous pegmatitic magma, been a calcite limestone, the resultant chief lime silicate, instead of diopside or tremolite, would probably have been the simple silicate of lime, wollastonite, as is the case, for example, at Matehuala, in Mexico, where wollastonite has been developed in great quantity by silication of the limestone, but where neither diopside nor tremolite (both silicates of magnesia as well as lime) has been formed.

The formation of dolomite from hot magnesian waters, indicated at Glenwood Springs, in Colorado, as described above, together with the fact that at Aspen the dolomite forms a "jacket" around and near the orebody, indicates that the formation of dolomite (and magnesite) by hot waters at moderate temperatures may be widespread; and further suggests that the dolomite enveloping the orebodies at Aspen and elsewhere may be to some degree the work of hot waters given off from the crystallizing sulphides. This effect would not be noticeable at Edwards, where the country rock was already dolomite; but is noticeable not only at Aspen but in the zinc-lead deposits of Missouri and neighboring states.

The Magmatic Sequence at Edwards

The sequence of magmatic events at Edwards, therefore, as stated, would be:

A. Laurentian magmatic cycle.
   1. Surgence of Laurentian granitic rocks (not displayed in the immediate field).
   2. Dolomization of Grenville limestones by hot magnesian water or water vapors.

B. Algoman magmatic cycle.
   1. Surgence of Algoman granitic rocks (not shown at the mine, but occurring in the neighborhood of it).
   2. Surgence of a siliceous superpegmatitic granitic magma, (derived from underlying rock magma), pegmatizing the quartzite beds and altering the dolomite beds partly to pyroxene and hornblende.
   3. General alteration of pyroxene and hornblende to serpentine and talc by a drenching of hot water vapors from below.
   4. Local injection of zinc-iron ore magma, limited in amount.

[23] C. H. Smyth, *Op. cit.*, p. 19.
[24] "The Ore Magmas," Vol. II, pp. 550, 809.
[25] Newland, *Op. cit.*, p. 23.
[26] *Trans*, A.I.M.E., Aug., 1923.
[27] Mono. XXXI, U. S. Geol. Surv., pp. 209-216.
[28] C. E. Elebenthal, Bull. 606, U. S. Geol. Surv., p. 15.
[29] *Op. cit.*, p. 4.

Borehole Surveying by the Kiruna Method

This New Way, Developed and, It Is Claimed, Successfully Used in Sweden, Employs Electrolytic Deposition of Copper Instead of Etching by Acid

By Sven Lundberg
The Swedish Diamond Rock Drilling Co., Stockholm, Sweden

IN THE SAME PROPORTION as diamond drilling has gained extensive use, the efforts to determine the actual course of the drill holes have increased. It has been proved that deep drill holes can deviate considerably from their intended directions, a fact that in many cases may have a decisive influence on the interpretation of the drilling result gained.

The matter of surveying boreholes has naturally been a subject in which wide interest has been taken and in the study of which extensive experimental work has been done. A large number of methods and instruments for this purpose have been described in technical literature. Many of these, however, can hardly be considered save as untried suggestions to aid in solving the problem, whereas others have been tried and have proved available under certain favorable conditions. The best apparatus devised hitherto has involved the use of a compass needle to indicate the direction of drill-hole deviation. Further, this apparatus requires much space and cannot be used for surveying drill holes of small diameter.

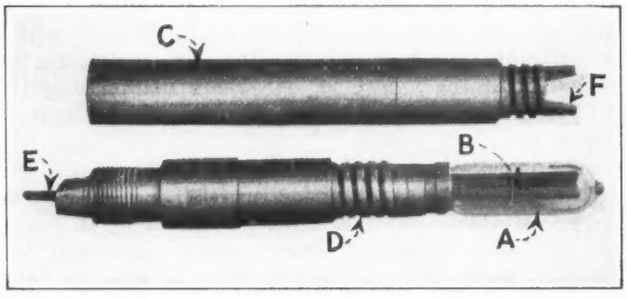


Fig. 1—Registering apparatus used in the Kiruna method of surveying boreholes

A, glass vessel containing electrolyte and electrodes. Anode has been removed to make cathode, *B*, visible. *C* is the steel tube casing, which fits over *A*. It has a female thread at left end which screws on to male thread *D*. *E* and *F* are terminals.

In Sweden, which is rich in magnetic minerals and where diamond-drill holes are generally drilled with relatively small diameter, a method of more general application for surveying drill holes has long been sought.

After many years' work the Swedish Diamond Rock Drilling Co., whose business continually brings it into contact with this surveying problem, has worked out a good and reliable method for measuring deviations in the drill holes. This method has been called the Kiruna method, after the iron-ore field in the north of Sweden, where the method was first used.

Swedish Society Aided in Developing Method

It must here be said that the Jernkontoret—the Swedish Iron and Steel Society—has helped greatly in working out the new method. This society in 1919 appointed a committee to study causes of deviation of drill holes and to investigate the accuracy of available surveying methods. Much of its time the committee naturally devoted to testing the Kiruna method, and it has contributed greatly to its development by examining the principle involved from both the practical and the theoretical points of view.

The committee report[1] which was read in 1922 before the society by Walfrid Petersson, professor in mining at the Royal Mining School of Stockholm, contains a complete mathematical analysis of the Kiruna method.

The Principle of the Method

If a cylindrical tube partly filled with liquid is let down into a drill hole, the outline of the surface of the liquid will form a circle on the cylinder wall if the hole is vertical, but an ellipse if the hole is inclined.

The form of the ellipse determines the inclination angle. The great axis of the ellipse shows the direction of the drill hole at the place where the measurement is made.

By means of two or more such tubes of liquid rigidly connected a certain distance apart in a hole, it is possible to find out from the form of the ellipses and the directions of their great axes both the amount and the direction of the deviation.

To elucidate the principle mathematically, it is necessary to name certain angles:

The angle between the tangent to the center line of the drill hole at a certain point and the vertical line is called the *zenith angle* (θ).

As above stated, the surface of the liquid in the cylinder which is let down into an inclined drill hole forms an ellipse. If a vertical plane is passed through the axis of the cylinder, this vertical plane contains the apsides (the great axis) of the ellipse and is there called the *apsidal plane*. The section of the apsidal plane with the horizontal plane is the *direction* of the drill hole and is expressed by the *north angle* (α) which is measured from a direction indicated above the ground, for instance the geodetic X axis.

If the north and zenith angles are known at a number of points in a drill hole, the center line of this hole is approximately determined, more exactly the more determinations made.

The north angle, however, cannot be recorded directly, but is determined by aid of the *apsidal angle* (ψ) which is the angle between the apsidal plane and a plane going through the cylinder centrum and a generatrix, imagined or, for instance, drawn with a scriber on the cylinder casing.

If a generatrix is drawn on a cylindrical tube and the tube is bent so that its centrum line forms a double-bent curve, the generatrix will assume a certain curve. Approximately it may be said that the curve of the generatrix becomes a curve parallel to the center line of the tube. Experiments conducted support this hypothesis. Under this assumption the relation be-

[1]Walfrid Petersson, "Metoder för Mätning av Avvikelser i Djupborrhal." Jernkontorets *Annaler*, 1922.

tween the variations of the north angle, Δa, and those of the apsidal angle, $\Delta\psi$, is the following:

$$\Delta a = \frac{\Delta\psi}{\cos\theta}$$

Thus it is possible to survey drill holes, for out of the above formula the change of the north angle can be calculated from point to point, after the zenith and apsidal angles have been measured. In this way the position of the tangents to the center line of the drill hole is determined at a number of points, and the course of the hole can be approximately determined by calculating the unclosed traverse of which these tangents are the component parts.

The angles, measurement of which is necessary for surveying according to the Kiruna method, are determined by means of electrolytic "registration." This is done by sinking a cylindrical vessel containing a galvanic bath down into the drill hole and then precipitating a metallic coat on a cathode, which is immersed in the bath. The outline of the coat shows the position of the cathode in relation to the horizontal plane.

If the cathode is of cylindrical form, the outline forms either a circle or an ellipse.

The registering apparatus, which is shown in Fig. 1, consists of the electrolyte vessel *A* and the anode connected with it; the electrolyte; and the cathode, *B*, on which the precipitation is made.

The electrolytic vessel is a cylindrical glass tube, the longitudinal axis of which coincides with the axis of the drill hole at the measuring place. The electric current is supplied from a battery above ground through a bottom contact connected with the anode by means of a pin through the glass. The anode is a thin copper sheet (invisible in Fig. 1) closely fitting the glass tube on the inside. At the top the tube narrows into a neck encompassed with a threaded ring connecting the glass tube with the fastening of the cathode.

The electrolyte is a solution of copper sulphate.

The cathode is a gilded copper cylinder carefully polished.

The registering apparatus is enclosed in a steel tube, the external diameter of which should be such as to permit it to fit closely in the drill hole.

As mentioned above, the principle of this method of measuring is to precipitate copper on the cathode cylinder and to determine the wanted angle values from the position of the precipitation outline.

How the Angles Are Determined

The zenith angle, θ, is determined by observing the greatest (h_{max}) and the smallest (h_{min}) height of the precipitation on the cathode cylinder, as shown in Fig. 2.

The zenith angle is obtained from the relation:

$$\tan\theta = \frac{h_{max} - h_{min}}{d}$$

where d is the diameter of the cathode cylinder.

The apsidal angle, ψ, is determined by measuring the precipitation heights at four generatrixes located 90 deg. of arc from each other, beginning from the one to which the apsidal angle refers. The heights found in this way are called:

$$h_0 \qquad h_{90} \qquad h_{180} \qquad h_{270}$$

These figures give two zenith angles θ_1 and θ_2, showing the dip of the elliptical surface of the fluid in two directions, at right angles to each other:

$$\tan\theta_1 = \frac{h_{180} - h_0}{d}; \quad \tan\theta_2 = \frac{h_{270} - h_{90}}{d}$$

If θ_1 and θ_2 are known, the direction of the great axis

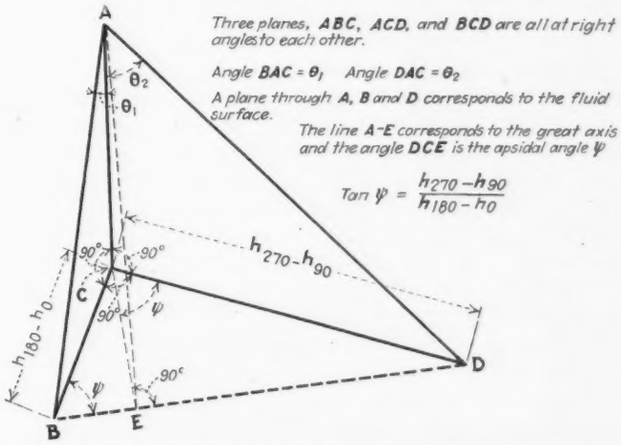


Fig. 2—Sketch illustrating method of determining zenith angle θ

of the ellipse also is known. This statement is proved by the schematic drawing in Fig. 3.

The precipitation heights are measured by aid of an instrument specially constructed for this purpose, a microscope with adjustable optic tube, in which there is placed a measuring scale graduated in tenths of millimeters.

With regard to the precision possible in determining the zenith and apsidal angles by means of electrolytic registration, it might be said that this measuring method is superior to all others thus far devised for the same purpose.

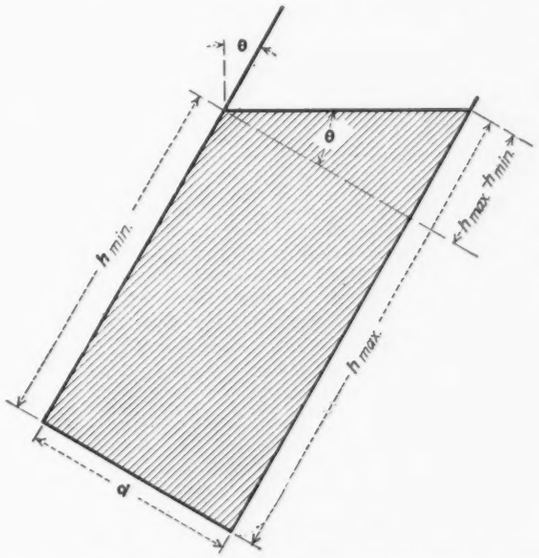


Fig. 3—Sketch illustrating method of determining apsidal angle ψ

It is true that adhesion and capillary phenomena have a certain disturbing effect upon the angle registration, but these influences are quite neutralized by

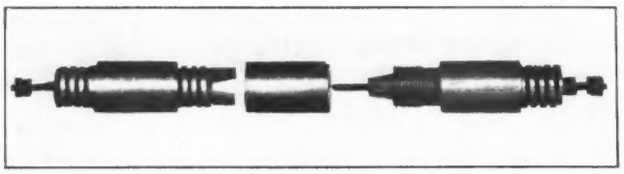


Fig. 4—"Orientating coupling" which prevents torsion between two rods

subjecting the angle values determined to certain corrections, which can be determined for each case, not only in an empirical but also in a theoretical way. Thus it is possible to determine the zenith angle to as close as 15 minutes, which is very satisfactory.

When determining the apsidal angle a somewhat lessened degree of accuracy is to be expected. When the zenith angle is small—that is, when the drill hole is more or less vertical—the average error to be counted on is rather large. For a zenith angle of 5 deg. the average error of the apsidal angle will be about ±5 deg. and for a zenith angle of 10 deg. about ±3 deg.

Procedure in Surveying

The manner of proceeding when surveying a drill hole according to the Kiruna method depends on the accuracy possible in measuring the apsidal angle. The first step is to study the general dip of the drill hole. This is done by lowering an electrolytic registering apparatus, hung on a steel wire. The zenith angle is measured at several points—for instance, at every 200 or 300 ft.

If the zenith angle is at least 15 deg., the accuracy in measuring the apsidal angle will be such that the following procedure, known as "successive bearing," may be used: A string of drill rods of suitable length, 30 to 100 ft., is lowered by a steel wire into the drill hole. At each end of the string of rods is placed an electrolytic registering apparatus. Both sets of apparatus have to be rigidly orientated to each other—that is, orientated to a generatrix on the string of drill rods.

The first registration is made with the upper apparatus in the mouth of the drill hole so that the traverse to be run can be referred to a fixed direction on the surface. The lower apparatus gives the position of the lower end of the rod string. Then the whole string is lowered until the upper apparatus is in the position occupied by the lower apparatus during the first determination and a new registration is made. In such manner the drill hole is surveyed by successive determinations length after length.

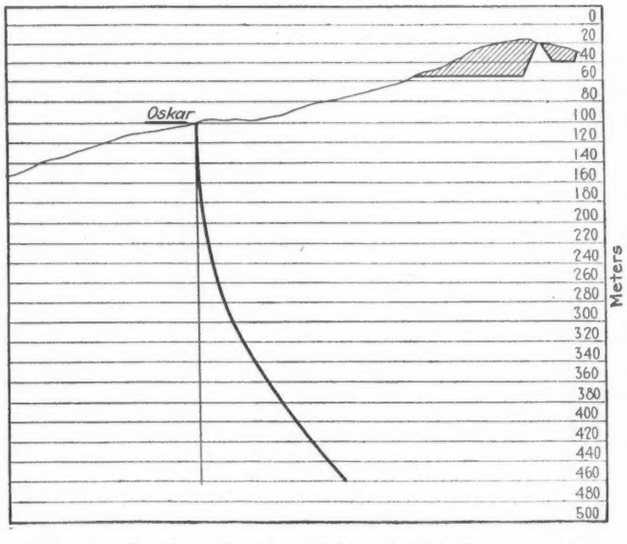


Fig. 5—Section showing Oskar drill hole in vertical projection

If at the time when the preliminary dip investigation is made, the drill hole is found to be more or less vertical—that is, the zenith angle is less than 15 deg.—another method of procedure must be used. The determination of the apsidal angle in such a case, as already said, would be uncertain. The procedure of "successive bearings" would be risky, for any errors made would be cumulative and might render the whole survey worthless.

To avoid having possible errors add up, a procedure known as "orientation from the surface" is used. This procedure is to let down from the surface a string of drill rods along which a generatrix has been marked. Part of the string is kept out of the hole in order to orientate the generatrix to a fixed direction on the surface. Sets of registering apparatus are inserted in this rod string at suitable distances, say 150 to 200 ft. from each other, and orientated to the generatrix mentioned.

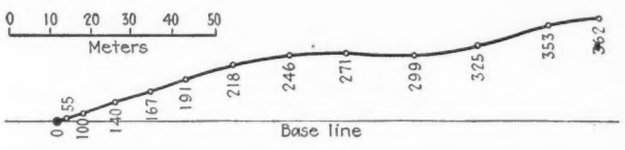


Fig. 6—Sketch showing Oskar drill hole in horizontal projection

At the start of the experimental work the generatrix necessary for orientating the registering apparatus was marked on the outside of the rods. However, this scribing method proved unreliable and was replaced by using a device which has received the name of "orientating coupling." This coupling is so constructed that a torsion between two rods joined by it is made impossible. The construction of the device is shown in Fig. 4.

The rod string is composed of drill rods which are screwed together by ordinary couplings in lengths suitable to handle. The joints are pitched or nailed to prevent them from becoming loose. At each end of these suitable lengths is put an orientating coupling, so that when the lengths are screwed together to form a long string, both of the end couplings are orientated to each other.

When the rod string with the sets of registering apparatus has been lowered into the drill hole, the electric current from a battery on the surface is switched on. The current is conducted down through the drill rods by an insulated copper wire. The anode of the lowest apparatus is connected to the rod string.

In order to control the manner in which the precipitation takes place and to judge the length of time it ought to last, it is advisable to shunt an extra registering apparatus visible above the ground.

When sufficient precipitation is obtained, the rod string is removed from the drill hole. The precipitation heights on the cathodes are measured and the

zenith and apsidal angles calculated from the formulas given above.

This method of surveying with orientation from the surface, however, is slow and comparatively a time-consuming work. Therefore the method of surveying with "successive bearings" is generally to be preferred, if conditions permit its use. In most cases the two methods of procedure are combined. For instance, when surveying a hole vertically set, orientation from the surface is used down to the point where the zenith angle is large enough to allow surveying with successive bearings.

Method Sufficiently Accurate for Purpose

It must be clearly understood that the accuracy of the Kiruna method is not as great as that obtainable in land surveying with a theodolite. The Kiruna method is intended solely for surveying drill holes—that is, to give information as to the courses of drill holes that is sufficiently accurate for practical purposes. The Swedish Diamond Rock Drilling Co. has proved that this new method fully answers its purpose.

One of the first tasks this company undertook to perform by this method was to survey a drill hole at Kiruna, that had struck an underground room—a tunnel—at a depth of 450 ft. It was intended to be a check on the method before it was used for other holes at the same mine. The test hole, which was set vertically, was found to have deviated so that the zenith angle at the bottom was about 5 deg.

The position of the bottom of the drill hole indicated by the survey according to the Kiruna method corresponded very well with the actual position determined by the mine survey, the difference amounting to less than 2 ft.

This good result with the new method led to the surveying of all important drill holes at Kiruna.

One of the most important drill holes for calculating the ore reserves was the 1,300-ft. hole, known as the Oskar hole. As it was known that the hole had curved greatly, it was very desirable to find out in which direction it had deviated. This was accomplished by a survey according to the new method. The result is shown in Figs. 5 and 6. The horizontal projection in Fig. 6 is drawn on a larger scale than that which is used for the vertical projection in Fig. 5. Repeated surveys of the same hole gave identical results, so that the map of the hole may be considered accurate.

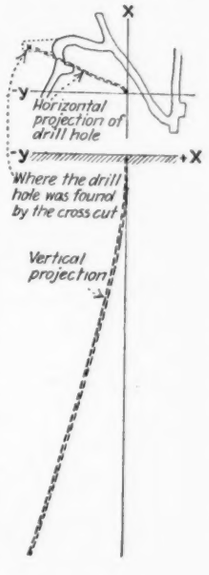
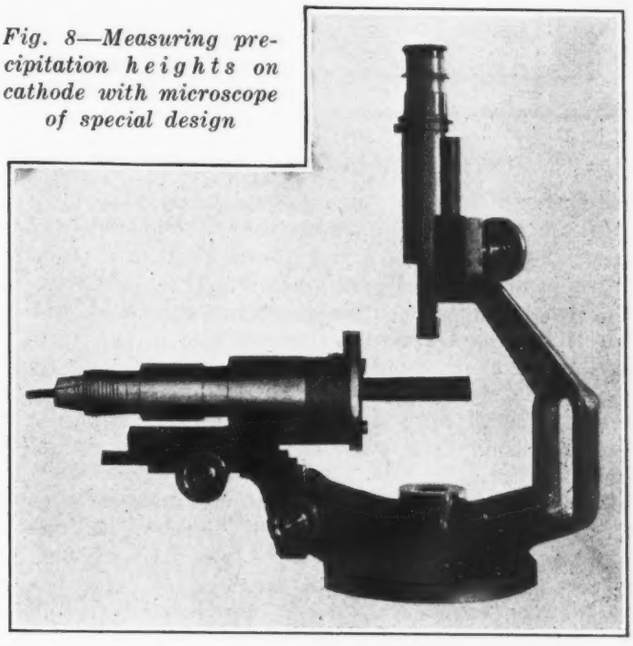


Fig. 7—Horizontal and vertical projections of drill hole No. 59 at Rostvangen mines, Norway

The best demonstration of the accuracy of the Kiruna method, however, was gained at Rostvangen mines, in Norway. A drill hole, vertically set, had struck ore at a depth of 430 ft. When a tunnel was driven for the ore, however, it could not be found. The Swedish Diamond Rock Drilling Co. was asked to solve the mystery. The drill hole was surveyed and found to have deviated considerably from its initial direction. The course of the hole is indicated on a map, shown in Fig. 7. A short crosscut was driven from an underground working after taking the direction from the map mentioned.

Fig. 8—Measuring precipitation heights on cathode with microscope of special design



The end of the drill hole was found almost exactly at the spot where it had been indicated to be.

Bewails Lack of Metallurgical Progress in Britain

In the leading article of the London *Mining Journal*, issue of April 5, the editor pays a compliment to American metallurgical progress as follows:

"Our readers will have observed from time to time the numerous and varied records of original metallurgical work carried out in the States, and published under the auspices of the U. S. Bureau of Mines. On the other hand, they will note with regret almost the entire lack of *real* metallurgical work or useful metallurgical research emanating from the schools and universities in this country.

"This is a matter greatly to be deplored, but we cannot shut our eyes to the obvious decadence of one of our oldest industries. Signs were not wanting, prior to 1914, that the metallurgical industry of this country was waning, and since that period it is more than ever patent that we no longer lead in this branch of professional work; in fact, we are lagging a long way behind. No new innovations or modifications of existing processes have been propounded, and research work in metallurgy, as distinct from metallography, is almost at a complete standstill.

"The States are pushing forward, without stint of adequate funds, into both extensive and expensive investigations: the use of oxygen-enriched air for iron smelting in the blast furnace and for roasting zinc ores, chloride volatilization of metals from their ores, investigations in explosives and fuel economy are merely a few examples to which attention has been recently drawn in the *Journal*. Admitting that the States is the wealthiest country in the world, and that money can, and is, apparently being poured out like water for research, is it not one of the signs of the times that no adequate provision is being made in this country for pioneer work in a similar direction?

"For this absence of enterprise in the United Kingdom it would appear that the causes are attributable either to the lack of suitable men for carrying out research work—which might be attributed to the wrong type of man entering a moribund profession—or, on the other hand, may equally apply to the fact that the teaching of metallurgy, as distinct from metallography, in the present generation appears to be regarded as of scant importance."

DISCUSSION

The Use of Trimmings

THE EDITOR:

Sir—A few evenings before your *Journal-Press* of March 22 came to hand I was discussing with a friend the use of university degrees and other titles in matters of personal advertisement as well is in technical journalism. I had, as I thought, trimmed him in the argument, when along came your editorial on "Simplicity in Technical Journalism." It puts arguments in the control of my friend's logic, and naturally I am peeved that unwittingly you have given him assistance unsought.

This together with the fact that you have reverted to that stale joke about the O. B. E. forces me to take up my pen in defense of some of the titles we hold so dear. (I am not referring to the I. C. S. or the Nobel Prize, valuable as either may be). You may not remember that a British member of Parliament—neither a Whig nor a Tory—was all but thrown out of the house for fabricating the travesty that you have repeated—and that as though it were original.

After the war few people accepted the rendering of the O. B. E. as you have given it, because it was generally known that it was an Order Bestowed upon Everybody. Joking or no joking apart, your comment on such a democratic title is entirely out of place, especially when composed in a land where colonels are as common as generals in Mexico and where the liberty-loving (I trust the hypen is correct) multitude insist upon calling lawyers (and other trouble-makers) judges.

The use of university degrees, or as you call them "trimmings," is necessary for a lot of us who have not attained the greatness, though we hope for it, of a Spurr, a Hoover, a Rickard, or a Mathewson. Why in the mad desire for simplicity will you deprive us of the only greatness we possess? However, in the desire to co-operate with you in the struggle for that simplicity so devoutly to be wished, may I ask the real meaning of the overworked combination "caudal appendage"?

Anticipating greatness, but not possessing any decorations, may I sign myself,

ALEX. SMART, B.A., B.Sc.

A Tariff on Copper

THE EDITOR:

Sir—I have read with interest your editorials and letters addressed to you in recent issues of your esteemed magazine relative to a tariff on copper. You no doubt agree that an increase in price of copper would be beneficial to the copper industry, but it seems you doubt that a duty of 5c. per pound would tend to increase the price, which position is also taken by Mr. Walker in a letter in your March 22 issue.

It seems to me that this question hinges on the exportable surplus which you mention but do not state the amount and which Mr. Campbell in his letter intimates is negligible.

Other authorities have recently stated that the domestic consumption now practically equals production and will undoubtedly overhaul it in a very short time. If this is the case, I do not see how a tariff on copper can fail to increase the price. In other materials such as wool, of which we are obliged to import a part of what we consume, there is no question that the tariff increases the price which the producer obtains.

I would be very much obliged if you would publish in an early issue the figures on our exports and imports for 1923—that is, the amount of copper we export and amount imported and produced by the cheap labor of South America, Africa, and Mexico.

Even if, as Mr. Walker suggests, the American producers foolishly increase production under a tariff to such an extent that this will cause a big drop in price, the tariff will at least have given employment to a greater number of miners and tended to reduce costs of production by increasing it.

At any rate I must agree with Mr. Campbell that a tariff on copper cannot harm the industry and may help it greatly.

E. G. WENTWORTH.

San Antonio, Tex.

Following are the figures on imports and exports requested by Mr. Wentworth, for 1923 and 1922 as well:

Imports of Copper during 1922 and 1923

Kind	Copper Content, Pounds 1923	1922
Ore	90,152,703	71,203,126
Concentrates	49,964,288	32,907,671
Matte, coarse, metal, cement copper	2,960,849	8,728,039
Unrefined copper metal	394,645,037	302,579,228
Refined copper	129,086,204	103,143,142
Scrap copper	5,523,849	21,341,415
Composition metal, copper chief value	4,202,441	1,110,599
Copper manufactures	175,716	.....
Brass, largely scrap, 41,471,150 lb. in 1923 143,924,404 lb. in 1922 Assume 80 per cent as copper	33,176,920	115,139,523
Total, in all forms	709,888,007	656,152,743

Exports

Ores, concentrates, and unrefined copper	339,212	232,191
Refined copper	729,380,207	652,666,939
Scrap copper	3,544,545	2,800,862
Composition metal, copper chief value	119,963	221,473
Pipes and tubes	2,613,393	1,822,580
Plates and sheets	4,535,743	6,748,454
Rods	62,693,305	52,188,596
Wire	9,842,992	11,600,480
Insulated wire and cable	11,681,450	8,575,745
Other manufactures of copper	4,563,192	6,182,568
Foreign copper	921,000	3,475,241
Brass and bronze, assume 80 per cent copper	24,801,979	17,598,734
Total	855,036,941	764,113,863
Excess of exports over imports (exportab'e surplus)	145,148,934	107,961,120

These figures are the official figures published by the U. S. Department of Commerce.

The actual exportable surplus is somewhat greater than the figures indicate, for several million pounds of copper are exported annually as electrical machinery, automobiles, chemicals, ships, railway equipment, ammunition, and in other articles of minor importance. Some is also imported in similar forms, but the amount is not so great.—THE EDITOR.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary of the Week

CURRENT production of zinc concentrate in the Joplin-Miami district is just under 14,000 tons per week. The decline in the price of zinc has forced six concentrators to suspend operation since April 1.

An increase in smeltermen's wages of 25c. per shift has ended a brief strike at the Salt Lake Valley smelters, in Utah.

Negotiations are under way looking to a co-operative arrangement whereby the Hercules company will mine and mill the ore recently opened by the Ajax tunnel in the Coeur d'Alene district of Idaho.

Resumption of operations by the Mason Valley Mines Co. in Nevada is reported. The Bluestone flotation plant may be enlarged.

Officials of the Arcadian Consolidated Mining Co. deny reports of further assessments this year.

The Central Eureka Mining Co. has purchased the neighboring Old Eureka property at Sutter Creek, Calif., for $150,000.

Isolation of the fire recently discovered in the Sacramento mine at Bisbee, Ariz., has been successfully accomplished by bulkheading.

From Mexico City come reports that the government will adopt a lenient policy in regard to the cancellation of mining-claim patents for non-payment of taxes prior to April 30.

Profitable operation of the Chichagof mine in Alaska has followed the recent reopening of the property by the Chichagof Exploration Co.

A saving of $300,000 annually as a result of the revision of the Dominion tax budget is anticipated by the mining companies of Canada.

Hercules and Ajax May Co-operate in Exploiting New Ore

Day and Bixby in East—Hercules Ore Reserves Low; Ajax Lacks Adequate Equipment

After serving notice on the Ajax Mining Co. that as the ore recently struck by the latter company was on a claim owned by the Hercules Mining Co., and requesting that no more ore be moved until rights of ownership had been determined, Harry L. Day, president of the Hercules, left for Pittsburgh. A few days later A. C. Bixby, manager of the Ajax, left for the East to confer with Ajax directors who reside at Lynn, Mass. It is now understood that a conference is being held in the East between the Ajax directors and Mr. Day with the view to reaching an agreement.

Though nothing has been given out indicating the basis of the conference, it has been suggested that an agreement may be reached by which the development and operation of the Ajax may be taken over by the Hercules. It is common knowledge that unless new ore is made available, the exhaustion of the Hercules is not far away. Even with its rights to the ore secure, the Ajax is confronted with a large expenditure for development and milling facilities to place the property in condition to realize a profit. On the other hand it is pointed out that with a comparatively small expenditure the Ajax ore could be reached from the Hercules workings and with its ample facilities the Hercules company could soon have the Ajax on a productive basis.

Old Jackson Mill Resumes at Idaho Springs, Colo.

THE old Jackson mill, at Idaho Springs, Colo., after a thorough overhauling and remodeling, went into operation April 10. Initial work will be confined to the treatment of about twenty-five tons daily from the Dunkirk mine, which is owned by the company.

The flow sheet comprises coarse crushing, jigging, regrinding, table concentration, and flotation. The management announces that, if successful, the mill will be enlarged for custom work, and a 25-ton Mace smelting furnace installed.

Small Smelter Installation at Black Hawk, Colo.

The H. & H. Smelting Co. is installing a 25-ton Mace smelting plant at Black Hawk, Colo., and expects to be able to blow in during the present month. The unit is designed wholly to treat pyritic ore. Later the management states that if the ore justifies that course, a lead unit will be added.

J. F. Duthie Ships $1,400 Lead-Silver Ore to Selby

Highland Basin Group Looks Good—Funds Came From Recent Sale to A. S. & R. Interests

The goddess of fortune seems to be staying with J. F. Duthie, who brought the Henderson and Mamie groups, on Hudson Bay Mountain, 13 miles from Smithers, B. C., to a producing stage, and then sold a controlling interest in them to the Federal Mining & Smelting for $250,000. Since the Federal took control last fall, more than 1,500 tons of ore, averaging around $200 per ton in silver, gold, and lead, has been shipped to the Selby smelter.

At the time Duthie made the sale he expressed his intention of investing the money in the development of other prospects in the district, and, a little later, he bonded the Highland Basin group, in the Babine range, 25 miles from Smithers, from Thomas King and Martin Cain, and at once set about to develop it. Recently Mr. Duthie sent a small trial shipment to the Selby smelter, which ran 170 oz. in silver and 66 oz. in gold per ton, and a small amount of selected ore ran 850 oz. in silver and 467 oz. in gold per ton.

The prevailing high price of lead, it is thought, will result in the reopening of many silver-lead properties in the district, despite the comparative high cost of transportation.

Chichagof Mine, in Alaska, Reopened, Nets Good Profit Under New Management

THE Chichagof mine, in the Sitka district, Alaska, which was closed last July, after producing, in round numbers, $12,000,000 in gold and silver from 400,000 tons of ore, and disbursing $6,000,000 in dividends, is again in profitable operation. The stamp mill was restarted at the end of January. The value of the February production was $31,000, of which $10,300 was profit, and the March production $35,000, of which $14,000 was profit. G. T. Jackson, formerly superintendent for the Jackling interests in Alaska, and associates, as the Chichagof Development Co., are operating the property.

When the mine was closed, the operating expenses were in the neighborhood of $12 per ton, so ore below that value was left in the mine. Mr. Jackson became interested, and from his examination he estimated that there was 40,000 tons of $12 ore and more than that amount of ore running around $10 per ton, all of which, he estimated, could be treated at a cost of about $5 per ton. The purchase and restarting of the property cost less than $100,000 it is said.

Benperce Mining Co. Buys Manganese Claims at Silver City

Boston Hill, overlooking Silver City, N. M., gives promise of expansion in its production of manganiferous ore. The Benperce Mining Co. has purchased the manganese claims of the Silver Spot group on the hill, and with this addition to its property will be able to increase output to 100 tons per day immediately. A market for this ore is now open, as the C. F. & I. Co. has increased activity in the rail-mill of the plant at Pueblo, Colo. The Silver Spot property produced manganese ore during the war.

White Caps Mill To Be Shut Down Pending Shaft Sinking

It is reported that milling operations will be suspended at the White Caps mine, in Manhattan, Nev., and that the main shaft will be sunk probably 500 ft. deeper. The report of the general manager states that all principal stopes in the mine have shown an increase in antimony content to such an extent that mill recovery has appreciably decreased, and it is not possible to operate at a profit on this class of ore. Indications are that antimonial content is decreasing with depth, and for that reason it is recommended that the shaft be sunk an additional 500 ft. and the oreshoots developed at that depth.

Wellington Mines Retimbers Oro Shaft

The Oro shaft of the Wellington Mines, at Breckenbridge, Colo., which had been idle since 1892, because the pumping plant at that time could not handle the water at the 480 level, has been retimbered and put in working condition.

The property was formerly worked for a lead carbonate ore. The zinc could not then be profitably mined, and was left in the stopes. The company now makes a high-grade zinc concentrate, and R. M. Henderson, manager, thinks older levels will yield large quantities of zinc ores in addition to the lead ore yet to be mined from the lower levels.

A drill hole from the bottom of the Oro shaft drains the water to the lower workings of the company's property, where it is easily handled by the big pumping plant. The drill hole also discloses that the ore extends down the shaft, and would seem to promise large reserves of lead and zinc ores in undeveloped territory.

May Develop Large Arsenic Property in Montana

One of the largest deposits of arsenical sulphide ore in the country is near Rimini, Mont. Fourteen patented claims have been obtained in a group and will be consolidated into one property, which will probably be incorporated under the name of Montana Lead & Arsenic Co.

C. W. Geddes, of New York, with associates, has been working upon this consolidation and now has enough property to justify immediate operations. Considerable work has been done on the Lee Mountain vein, which can be followed on the surface for more than a mile. This vein, where developed, shows a width varying from 50 to 100 ft. Different assay reports show an average of 5 per cent lead, 7 oz. silver, $1.80 in gold, and 12 per cent arsenic to the ton. Smelter returns from East Helena, Mont., and the International, at Tooele, Utah, on several hundred-ton shipments, show metal values of $39 per ton.

Mr. Geddes says that the operators are planning to erect a 100-ton test plant in the near future. The operation of this plant will then determine the future policy of the company.

Arizona Mercury Prospect Developed

The Porterie Mining Co., whose mercury property is situated about ten miles north of Phoenix, Ariz., is progressing with development and it is stated that arrangements are being made for the construction of a reduction plant. Several prospect shafts have been put down and other development has proven ore that warrants the continuation of the work. The schist formation, in which the mercurial ores are found, occurs over a wide area and other operators, working smaller properties, expect to start reduction soon.

Cheaper Electric Power Anticipated at Northern Colorado Mines

Absorption of Colorado Power Co. Which Serves Mines Will Effect Economy in Distribution

The absorption of the Colorado Power Co., which serves the mining districts of Boulder, Gilpin, Clear Creek, Summit, Park, and Lake counties, by the Colorado Public Service Corporation, which furnishes energy for Denver and northern Colorado, is expected to make possible lower rates for the mining districts served.

The Colorado Power Co. has a hydroelectric generating plant and storage reservoir in Boulder Canyon, and a second generating plant on the Grand River near Glenwood Springs. Its transmission lines reach Denver and penetrate the mining regions from Leadville north.

The plant equipment is too large for the limited territory, and the distributing system too expensive for the comparatively small market of the mining regions. Further, the plant has a generating capacity of wide difference between high water of the summer months and the scant flow of the winter months. In consequence the company has felt obliged to charge power users in the mining districts high rates in order to get any return for the heavy investment in an over-built plant.

The Public Service Corporation will be able to utilize the maximum output at high-water periods, using that much less coal at its steam-generating plants; and, in consequence, mine operators are hopeful of a power-rate adjustment that will greatly stimulate operations in Boulder, Gilpin, Clear Creek, Summit and Lake counties.

High Lead Prices Stimulate Production in Pioche, Nev.

Work has been started on the rebuilding of the tram terminal at Jackrabbit, destroyed by fire in January of this year, and shipments of silver-lead-copper ore will soon be resumed from the Bristol mine, near Pioche, Nev. At the time of the fire about four cars a week were being shipped to the Salt Lake Valley smelters, and the pleasing increase in the lead market influenced the management in changing its plans, it being at first decided to finance the running of the tunnel from the Jackrabbit side of the Mountain range through to the Bristol mine. This program, however, would, at best take a long time. The property is owned by the Snyder interests.

From the Combined Metals mine a consignment of 1,000 tons of ore is going forward to the plant of the National Lead Co., at Florence, Colo., and it is expected that by the time this consignment is taken care of shipments will go forward to the company's milling plant at Bauer, Utah.

Shipments continue from the Bullionville tailings, about four cars being shipped daily to the Garfield plant of the A. S. & R. Co. During the past two months about 15,000 tons have been shipped, and a substantial tonnage still remains. William H. Pitts, of Pioche, is the owner of these tailings.

Arcadian Consolidated Has Funds for This Year's Operations

Much Stoping Ground Already Opened —Excellent Ore on 900 Level— Await Better Market

Arcadian Consolidated probably will have enough money to carry it through the present year's operations in the Michigan Copper Country, according to R. H. Shields, president. There is no thought at this time of calling an assessment, he says, despite rumors to that effect. Arcadian is in the development stage, and its expenses are approximately $5,000 per month. Although it finished the last year with only $17,068 cash on hand, there was due $3,594.50 on Assessment No. 1 and $40,181.50 on Assessment No. 2, making a total of $60,844. All but $13,000 of the amount due on assessments has been received, and it is expected this balance will be paid. Another assessment will not be necessary until fall at least and probably not then.

Arcadian has all its supplies for the year and owes no money. Current bills are met promptly each month, and it has no bonded or other indebtedness. President Shields reports that in a good metal market Arcadian could be equipped for production even at the present stage of development. It has a large area of stoping ground already available in both the New Baltic and New Arcadian shafts.

The remarkable copper showing in the 900 level drift north from the New Arcadian shaft continues. For the last 400 ft., this opening has been in vein matter richly charged with copper. It is in the third distinct copper zone tapped by the two shafts. The lower or 1,250 level north drift is not yet in the third copper zone, but is developing occasionally good copper stretches. It is expected it will get into the third zone as it is pushed northward. A new hoist is needed for the New Baltic shaft to replace the plant destroyed by fire some time ago, but this investment will not be made until metal market conditions warrant.

Fire in Sacramento Mine at Bisbee Successfully Isolated

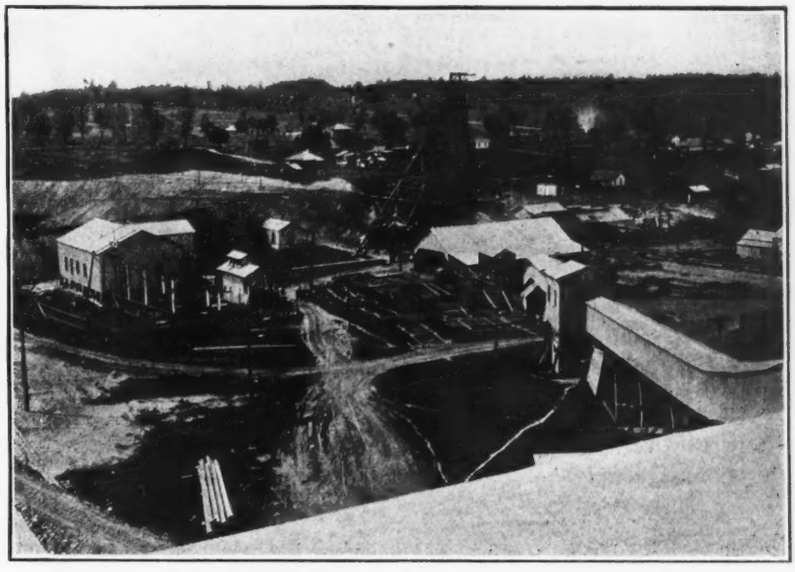
The fire which started in the Sacramento mine of the Phelps Dodge Corporation, at Bisbee, Ariz., on April 6 has been successfully isolated by bulkheads, and work has been resumed on all levels. It originated in a top slice stope just below the 1,300 level and is believed to have resulted from a blast. About fifty helmet men have been kept busy constructing stopings on the various levels since that time, the regular crews of the Copper Queen organization being assisted by the Calumet & Arizona team and by one crew of four men from the Globe-Miami district. The area that has been stopped off is about 600 ft. square, and bulkheads have been put in entries on the 1,100, 1,200, 1,300 and 1,400 levels. It is believed that the fire will not spread to the orebodies, as the sulphur content is not high in that area, and that all of the blaze is confined to the timber.

Plymouth Consolidated Will Deepen Shaft 900 Ft.

The Plymouth Consolidated Gold Mines, Ltd., at Plymouth, Calif., will sink its principal working shaft an additional 900 ft. to the 4,300 level. A contract has been signed for the sinking operations with the E. J. Longyear Co., of Minneapolis, Minn., and the work will begin soon. W. J. Loring, representing British mining interests, is in charge of the company's operations in California in addition to those of the Carson Hill property.

Rossland Camp, in British Columbia, Busy

Lessees at the O. K. mine, which adjoins the I. X. L. mine, at Rossland, B.C., have struck high-grade ore, similar to that found in the I. X. L., which yielded from $500 to $1,000 per sack. The lessees at the I. X. L. have another shipment ready to be sent to the Bunker Hill & Sullivan smelter as soon as the condition of the road allows. With the Consolidated company shipping around 700 tons per day and employing 350 men, Rossland is a busy camp again.



Shaft of the Plymouth Con. Gold Mines, Ltd., at Plymouth, Calif.
The main shaft will be sunk 900 ft. to the 4,300 level.

Central Eureka Acquires Old Eureka

The Central Eureka Mining Co. of Sutter Creek, Calif., has completed negotiations for the purchase of the Old Eureka mine, which lies north of the present holdings of the company. An initial payment of $10,000 has been made, and the deeds have been placed in escrow subject to further payment of $140,000 in three years. The total purchase price was $150,000.

The Central Eureka explored the neighboring holdings from its 4,250-ft. level and important ore discoveries were made.

Monida Minerals Co. Opens Lead Ore

The Monida Minerals Co. is developing its Pass Creek mine, near Bozeman, Mont. A good vein of lead ore has been cut in No. 4 tunnel. This orebody is thought to be the extension of the known orebody that has been mined on the upper levels.

It is reported that a 100-ton flotation plant will be erected within the next two months and that it will be necessary to install a 2,000-ft. aerial tram between the mine and mill.

The company has only operated in Montana for one year and during that time has confined operations to the development of the Pass Creek property.

Cresson Shaft Sinking Under Way

Sinking of the Cresson shaft, in the Cripple Creek district in Colorado, from the 18th level to an additional depth of 300 ft. was begun on April 12, and will be continued with two shifts, requiring, it is estimated, about five months for completion. The present plans provide for sinking direct 300 ft., with the cutting of a station at 150 ft., but no pumps will be installed here. A large station will be cut at 300, to be known as the 20th level. Here new pumps will be installed of sufficient capacity to handle any flow of water likely to be encountered at this depth, which is about 435 ft. below the drainage tunnel. Production for the first half of April corresponded to the previous month's rate, which established a new record for the mine.

Kennedy 100-Stamp Mill Crushes 435 Tons Per Day

The Kennedy Mining & Milling Co., of Jackson, Calif., has increased the number of stamps in operation from 60 to 80 and expects to have 100 stamps in operation by the end of April. The 100-stamp mill has been thoroughly overhauled and will mill its normal tonnage of 435 tons per day when the remaining stamps are again placed in operation.

Lower Zinc Prices Force Shutdowns in Joplin-Miami District

Present Production Rate Just Under 14,000 Tons of Concentrate Weekly—Much Prospecting—Crestline District Active

APPROXIMATELY 140 mines were producing zinc ore in the Joplin-Miami district at the middle of April. This is a decline of half a dozen from the first of the month, the reduction being explained by the lowering of zinc ore prices by several dollars a ton. Some leading producers state that they will be forced to close their properties if prices sink below the $40 figure for any length of time. Present production is just short of 14,000 tons per week, about 1,400 tons of which is being produce through night shifts. There is talk of discontinuing these shifts.

In the meantime, considerable sinking activity in development is under way. The Eagle-Picher Lead Co. has placed the Crutchfield mill, in the Crestline, Kan., field in operation. The Bilharz Mining Co. is preparing to drill out the Fallenback land, about two miles south of Galena. The Fort Worth Mining Co. is putting down a new field shaft. The St. Louis Smelting & Refining Co. is continuing its drilling in the Seneca field. M. G. West, W. T. Paylor and associates have taken over the State Line mine, northeast of Picher, and are drilling it preparatory to reopening it.

The Eagle Picher Lead Co. has taken over the Tom Brown mill, in the western part of the Picher camp, and is preparing to operate it. The Kansas Explorations Co. is beginning shaft sinking on its lease in the Crestline field north of the Ellis tract. It has been drilling this tract for the last year. The Underwriters Land Co. is about ready to place its mill in the Crestline field in operation. The Kansas Explorations Co. also recently took a lease on the Bell farm, near Carthage, and will put a prospect drill on it at once; and the Golden Rod M. & S. Co. has taken a drilling option on the Jefferson City mine, in the eastern part of the Picher camp, which has been unproductive for several years.

New Plutus Orebody of Chief Consolidated Beginning to Produce

Stoping was started on April 5 on the new orebody at the Plutus mine of the Chief Consolidated Mining Co. of Eureka, Utah. This orebody—discovered in a fissure continuing from the adjoining Mammoth mine of large production in the past—has in the short time since stoping was started produced forty mine cars of ore, and ore is exposed over a width of 10 ft.

The property is being operated through the Grand Central, also a Chief property, and the shaft of the latter will be worked two shifts to accommodate the ore from the new find. It is expected that within a few weeks the new orebody will be producing at the rate of a railroad car of ore daily. The ore at the point of the starting of the stope ran 60 oz. silver to the ton.

Conditions at the Plutus are favorable. The present strike indicates the opening of a vertical ore channel similar to those in the Chief.

United Western Exploring Holdings

The United Western Mines Co. has been recently reorganized and is reported to be amply financed to carry out a large program of development at the property at Oatman, Ariz. The new work will be directed at lateral exploration of veins that have been entered by previous operations, and will open areas that have been proven by drilling. The equipment at the property is said to be in good condition, and in view of the fact that the workings were well timbered it is not likely that much time will be lost in getting the work under way.

South Dakota's Gold Production in 1923 Totaled $6,463,184

According to the annual report of Otto Ellerman, state mine inspector, South Dakota produced minerals to the value of $7,019,775 during 1923. The value of production of the more important follows:

Gold and silver	$6,463,184
Aluminum silicate	3,400
Mica	4,016
Feldspar	3,000
Lithia ore	39,125
Gypsum	76,968
Bentonite	600
Quarries	398,859

There were employed an average of 1,662 persons at the mines and 143 at quarries.

Tonopah Mining Co. Will Work Treasure Hill

The Tonopah Mining Co. is preparing to do some active development work on Treasure Hill, near the old town of Hamilton, which is about 40 miles west of Ely. This camp was a famous producer in the 70's, and the ore was notably high grade. The ore occurs as siliceous replacements in limestone, the orebodies being irregular in shape and extending to shallow depths so far as developed.

Deep prospecting failed to produce results, and the camp was closed down and deserted in the late 70's for lack of ore. It is said that actual development in the immediate vicinity of the orebodies is rather meager, and that there is a strong possibility that some faulted segments of these early day bonanza orebodies may be found to exist.

Charles Mayotte, a well-known Nevada engineer, is to be in charge of operations under direction of H. C. Carlisle, consulting engineer for the Tonopah Mining Co.

Tonopah Has Fire Scare When West End Shops Burn

FIRE of unknown origin destroyed the electric and carpenter shop of the West End Consolidated Mining Co. at Tonopah, Nev., on April 14. A 30-mile gale was blowing at the time, and only prompt work by the firemen, aided by the corrugated iron covering of the building, prevented a very serious conflagration. The entire milling plant of the West End company was endangered, as well as a considerable section of the town itself. Loss is estimated at $1,500, fully covered by insurance. This small loss and inconvenience will, of course, have no effect on company operations.

Ontario Silver Shares on New York Exchange

The Ontario Silver Mining Co., owning and operating the Ontario mine at Park City, Utah, is having its stock listed on the New York Stock Exchange. Last year the Ontario mine—for many years owned and operated by the Bambergers, of Salt Lake City—was taken over by G. W. Lambourne and associates, who also control the Park-Utah and Park City Mining & Smelting companies. At the time of changing hands, the Ontario Silver Mining Co. was reorganized under the laws of Delaware. The capitalization amounts to 150,000 shares, with no nominal or par value. Mr. Lambourne has been made president of the new company and Paul Hunt, of the Park-Utah, is a director.

Daisy Mines of Rosiclare Company Not Injured by Water

The Rosiclare Lead & Fluorspar Co. has called our attention to the news item on page 299 of our issue of Feb. 16 concerning the flooding of the company's mines. It directs attention to the fact that the Daisy mines of the company are operating as usual:

"The fact is that the Daisy mines, an integral and important part of this company, and situated on the Rosiclare property, are in splendid condition, are and have continuously been producing at the rate of 150 tons per day, and have in no manner been injured by the water conditions. Our mill has been in constant operation on full time, six days per week. We now have 31,000 tons of finished product in our stock yard ready to be shipped."

We have made further inquiry concerning this correction; and our correspondent confirms the assertion that "The Rosiclare company is operating their Daisy shaft or mines." Evidently, therefore, the report concerning the Rosiclare company that "all underground operations are at a standstill" was far too sweeping. The statement of our correspondent should apparently have been confined to the Rosiclare mine of the Rosiclare company, and to the Fairview mines.—EDITOR.

Utah Smelting Companies Settle Strike with 25c. Increase

SMELTER employees at the Murray plant of the American Smelting & Refining Co. and the Midvale plant of the United States Smelting, Refining and Mining Co., both situated south of Salt Lake City, Utah, have accepted a 25c. increase in wages as a compromise on their original demand of 50c. per day. Workers at the Midvale smelter went out on strike on April 12, but on April 17 reconsidered the earlier action and accepted the 25c. increase.

The furnaces were kept running in spite of the strike. Wages now range from $3.25 to $5 per day.

Production May Be Resumed by Mason Valley Mines Co.

Preparatory Work Started at Nevada Copper Properties—Bluestone Flotation Plant May Be Enlarged

Indications are that the Mason Valley Mines Co., which now controls both the Mason Valley and the Bluestone copper mines, in the Yerington district of Nevada, is about to resume operations after several years' shutdown. The Bluestone flotation plant is to be enlarged from 750- to 1,000-ton capacity, and underground and surface improvements are being planned in order that the Mason Valley ore can be economically treated in the Bluestone mill. To accomplish this some shaft and tunnel work, as well as surface track construction, will be necessary.

It is also reported that some repair work is being done around the Thompson smelter, near Wabuska, and that the company is planning the installation of a reverberatory furnace. This installation depends to a large extent on the decision in what is commonly known as the Wabuska rate case, in which the Mason Valley Mines Co. asks a low differential rate on ore and concentrates from Plumas County, Calif., copper mines to Wabuska, as compared to the rate to Utah smelters. In the first decision, given some two years ago, the Interstate Commerce Commission ordered a decrease in freight rate to Wabuska, but the benefit was neutralized by the immediate action of the Western Pacific Railroad Co., which put into effect an "open-car" rate to Utah smelters which equaled the Wabuska rate.

Calumet & Arizona Mine Production Normal

Because of alterations that were under way on the dust chambers of the Calumet & Arizona smelter at Douglas, Ariz., the output during March amounted to only 978,000 lb., compared with 2,824,000 lb. during the previous month. The operations at the mines have not been curtailed, however, and the copper that was not produced in March will be handled at the smelter during April. The output of the mines during March amounted to 3,280,000 lb.

Goldfield Has Small Fire

The surface plant of the Reorganized Kewanas Mining Co., near Goldfield, Nev., was almost totally destroyed by fire of unknown origin on the night of April 9. The loss included the hoist, the compressor, and the inclosing buildings. The headframe and blacksmith shop were not badly damaged. New equipment is to be purchased immediately.

C. & H. Output at Low Ebb

Calumet & Hecla Consolidated production of refined copper in Michigan is at a minimum for the three producing units, conglomerate branch, Ahmeek and reclamation plant. Monthly output is not more than 5,500,000 lb. Production, however, can be easily increased whenever necessary. Tonnage from the conglomerate shafts is at the rate of 2,600 tons daily.

Blast furnaces at the Midvale smelter of the U. S. S. R. & M. Co., where a strike has just been settled

Washington News

By Paul Wooton

Special Correspondent

Senate Passes War Minerals Relief Appropriation Bill

Favorable House Action Expected—$1,200,000 Available If Needed

The Senate has passed the Oddie bill authorizing an appropriation of not to exceed $1,200,000 with which the Secretary of the Interior may pay adjudicated claims under the War Minerals Relief Act. The bill automatically has gone to the House and at the same time has been introduced there as a House measure by Representative Raker, of California. The House Committee on Mines and Mining is expected to make a favorable report at an early date.

Of the original appropriation of $8,500,000, there remains an unexpected balance of $1,738,000, deducting the amount of awards made since suspension of payments. Hubert Work, Secretary of the Interior, estimates that if claims or parts of claims heretofore denied by the secretary are not reversed as a result of litigation now pending in the courts, the sum remaining of the original appropriation will be sufficient or nearly sufficient to pay the claims which have not yet been adjusted. On the other hand, claims for property losses and for interest and other items which have been disallowed have been carried to the courts, and if a decision should be adverse to the government in these cases, the additional appropriation authorized by the Oddie bill would be necessary.

It is hoped by the Department of the Interior to carry forward the work of paying claims which have been adjusted at an early date.

Seek Increase in Tariff on Gold Leaf

The Tariff Commission has ordered an investigation of gold leaf under the flexible tariff provisions as the result of applications seeking increases in the duty fixed in the act of 1922. The applications were filed last May by the United States Gold Leaf Manufacturers' Association and the Gold Beaters Union of the United States, a labor organization. They stated that the present duty of 55c. per 100 leaves was insufficient to protect the domestic industry from German competition, owing mainly to the difference in wage costs in the two countries. The silver leaf, aluminum leaf and metal leaf industry of the United States has been wiped out on account of lack of tariff protection, the manufacturers stated.

El Cedro Mine, at Guanajuato, Will Be Revived

Antonio Madrazo, ex-governor of Guanajuato, Mexico, has organized La Union Mining Co., with a capital of 600,000 pesos. The intention of this corporation is to develop El Cedro mine, which is reported to have produced 50,000,000 pesos, but is at present under water. The principal object is to continue the Santiago tunnel, which begins in La Constancia property and later reaches El Cedro. This tunnel will have a length of 1½ km. in the heart of the Beta Madre of Guanajuato.

The new company will exploit the following claims: La Buena Suerte, La Confianza, Purisima del Cedro, Can Caralampio, and San Bruno. The installation of ball mills is planned.

Luis Vagan is president, Antonio Madrazo is vice-president and manager, and Farnando Calero is mine manager in charge of operations.

Mexico City Letter

By W. L. Vail
Special Correspondent

Mexican Government To Be Lenient in Tax Forfeitures

Cancellation of Mining Claim Patents on April 30 Will Depend on Circumstances—Revolt Upset Business

Mexico City, April 14 — Under authority given him by the new Mexican mining law, the Secretary of the Treasury proposes to exercise moderation in the question of cancellation of mining patents, where taxes have not been paid and properties are subject to forfeiture at the end of April. The official will take into consideration the present economic conditions produced by the recent revolt througnout the country, and is disposed to assist the mine owners as far as possible.

The new tax on coal, 5c. a ton for the crude article, 4c. on coke, and 3c. on coke with byproducts, has gone into effect. This is a special emergency tax to assist the government over the immediate crisis, and was not opposed by the owners of the coal mines.

A concession for the exploitation of falls on the Basaseachi River, Chihuahua, 12 miles east of the mining center of Ocampo, has been applied for by Vernon S. Sullivan and C. B. Ruggles, of El Paso, Tex. They propose the erection of a hydro-electric plant. There has been considerable activity in denouncements and exploration work in the Ocampo district since the first of the year.

French Corporation Plans Expansion

The Mining Corporation of Mexico (French capital) and the largest group of French mining interests in the country, at the recent annual meeting in Paris voted to increase the capital for the purpose of extending its operations in Mexico. Toward this end several subsidiary companies are being organized. The company has recently taken over the Pedrazinni mines and has also completed purchase of the Paraiso Novillero sugar hacienda, of several thousand acres. Heretofore most of the operations of this company were confined to Lower California.

It is reported that the Amparo Mining Co. (Jalisco) has acquired a controlling interest in the stock of La Piedra Bola Mining Co., in the same vicinity, and intends to increase the scale of operations.

An important event in mining circles of Mexico is the recent amalgamation of the Guanajato Development Co., the Pengiico Mines Co., the Peregrina Mining & Milling Co., the Mexican Milling & Transportation Co., Protectora y Anexas, Negociacion de Esperanzas and the Cia. de Minero, under a new holding company. All these properties are situated in the city of Guanajato and along the Mother Lode. The new organization also acquires the San Matias, Santo Niño, and Pegrina reduction plants, which will be enlarged and modernized, where necessary. Guanajato mining operators fortunately count on the support of an enlightened and progressive state government.

Breaks Silence of Fourteen Years

THE people of Marysville, Mont., recently celebrated the blowing of the whistle at the old Drum Lummon mine, when it spoke for the first time in fourteen years.

The St. Louis Mining & Milling Co. is working a crew of thirty men on the property. This crew will be increased as soon as the mill is ready to operate. The new power plant has just been completed. The mill was in a rundown condition, but it is said that at least twenty-five stamps will be in use by May 1.

Development work has been carried on successfully for several months. The ore bins have been filled as a result of this work, and much stoping ground has been opened up. A great part of the old workings are under water at this time, but they will soon be unwatered for development and exploration.

Troubles of Complex Ores, Ltd., in Australia

Complex Ores, Ltd., was the title of a company promoted by J. H. Gillies, of Melbourne, a few years ago to develop a process for electrolytic treatment of zinc concentrates. After carrying out experimental operations in Melbourne, Mr. Gillies obtained a concession from the Tasmanian Government to utilize the waters of the Great Lake for generating power. It was his intention not only to utilize this for the treatment of zinc concentrates but also for the manufacture of carbide and the supply of electricity in bulk to municipalities and other power consumers. Unfortunately before the first section of the power plant was completed the company got into financial difficulties and the Great Lake scheme was taken over by the Tasmanian Government, leaving a subsidiary company to Complex Ores, Ltd.—namely, Carbide & Electric Products, Ltd.—free to carry out the original metallurgical program. A start was made with the carbide works, and at this stage the Electrolytic Zinc Co., representing Broken Hill interests, stepped in, with the result that Mr. Gillies' original scheme has been carried out in its entirety but without any financial benefit to himself as the originator of it. Even the Carbide & Electric Products has failed to make good, owing to competition from abroad.

The company has received various advances from the Tasmanian Government and is indebted to it to the extent of £116,000, apart from liability to other creditors and the shareholders. The government recently appointed a receiver, who is now in charge, and an effort is being made to obtain fresh capital.

The carbide produced is of a very high quality, and the company claims that if the industry could be protected against dumping it would be in a position to supply the whole of Australian requirements at reasonable rates.

Johannesburg Letter

By John Watson
Special Correspondent

February Decline in Gold Output Due to Short Month

Price Off 2s. — Crown Mines Lead; Government Areas Second—Increase in Labor

Johannesburg, March 17—The Transvaal gold output for February was declared on March 10 as 760,617 fine ounces, having a value of £3,612,931. Compared with January, there is a decrease of 36,151 oz. in quantity and £251,394 in value. February is a short month and had only twenty-five working days, whereas January had twenty-seven. There has also been a drop of 2s. per ounce in the realized price of gold. The daily average output for February was 30,420 fine ounces, and this figure is an improvement of 910 oz. per day over the January average. Among the highest producers, Crown Mines comes first, with a monthly output of 65,190 oz., Government Areas comes second, with 63,267, Randfontein comes next, with 54,850, then New Modder, with 51,051 fine ounces. The returns of native labor show 182,500 "boys" employed on the gold mines, this being an increase of 841 over the January number.

News comes from Bulawayo that C. B. Kingston, on behalf of the African and European Investment Co., Ltd., has acquired an option over the Turk and Angelus claims, 30 miles from Bulawayo, in the Bembezi district. The Turk mine has been worked to a depth of 300 ft., where a reef 40 to 50 ft. wide is reported, with an average value of 9 dwts.

W. G. Latilla, of London, has recently spent some weeks in Rhodesia, where he visited most of the important mines. The Legion and the Turk appeared to be big mines in the making; the good results of the Cam & Motor and the encouraging outlook for the Shamva mine largely explained the renewed activity and justified optimism all round. The existing Rhodesian railway rates he considered prohibitive.

The Rustenburg correspondent of The Star reports that wagon loads of chrome ore are passing through that town, en route for the railway, to be shipped to London via Delagoa Bay. Two hundred tons have already been forwarded. Tests and analyses carried out locally show excellent values. Major Trevor, Inspector of Mines for the Pretoria district, has been over the ground and given favorable reports.

Electrolytic Zinc Co. Increased Output in 1923

During 1923 the Electrolytic Zinc Co., Ridson, Tasmania, recovered 41,158 tons of zinc, valued at £1,293,422 (as against 23,517 tons, valued at £705,390 in the previous year), and 107,004 lb. of cadmium, valued at £27,551. The total value of this company's 1923 output, therefore, amounted to £1,320,973 compared with £705,390 for 1922, an increase of £615,583.

London Letter

By W. A. Doman

Special Correspondent

Tharsis Sulphur & Copper Paid 10 Per Cent Dividend in 1923

Substantial Improvement in Last Three Years—Total Dividends 984.3 Per Cent—Cost Not Disclosed

London, April 8 — Although by no means back to its palmy days, the Tharsis Sulphur & Copper Co. (Spain) has made substantial recovery during the last three years. The actual net profits in 1921 were £45,945; in 1922 they were £71,279, and last year £97,173. Apart from about £1,100, the whole £97,173 is distributed in a 10 per cent dividend. Of the Tharsis mines the Sierra Bullones remains closed, though it is fully equipped and prepared for the extraction of ore on a large scale at short notice, whenever the condition of the pyrites market warrants it. Extraction has been confined to the Calañas mine, the quantity amounting to 293,185 tons, compared with 220,944 tons mined and treated in the previous year.

In the fifty-seven years of its existence the Tharsis company has made actual gross profits of £15,892,574, has written down the original assets of £3,321,358 (less sundry sales) by £2,780,110, and the mines stand in the balance sheet at £45,524. The shipping piers, of recent construction, now form the biggest asset, and the first cost of £262,672 has been written down to £209,845. Dividends paid reach £11,210,385, or 984.3 per cent. At the end of 1923 mineral in open casts and preparatory works was valued at £721,766. The company does not state its working costs.

Reduced Power Charge Helped Rand Mines

The annual report of the Union Corporation shows that at standard price the gold production of the Transvaal last year was £38,794,773, and mentions the probability of its reaching £40,000,000 this year and creating a record. The destination of the gold is given thus:

	Per Cent 1922	Per Cent 1923
India	37	40¼
Other Countries ...	4½	13¾
New York	58½	46

India remains the great sink, for though she absorbed less than the United States, much of it goes into hiding.

The Rand mining industry and the Victoria Falls and Transvaal Power Co. have compromised upon the charge for power, as a result of which the mines are estimated to save £220,000 per annum, or 2d. per ton. Economies introduced during the last two years have proved effective, as the working costs per fine ounce, which were 76s. 5d. in 1921, were 67s. 8d. in 1922 and 60s. 1d. last year.

Mason & Barry (Portugal) made a profit of £36,404 last year, and distributed the bulk of it in the form of a 17½ per cent dividend. Less ore was broken, but shipments were 177,067 tons, against 160,895 in 1922. The company was incorporated in 1892, and with the exception of 1918 has not been out of the dividend list. The total paid in dividends is £1,731,349, and, in addition, capital has been returned in cash —on which income tax was not payable —to the amount of £740,688, the £5 shares being reduced to £1 shares. The capital is now £185,172.

The Rio Tinto Co. is negotiating for the purchase of land on the south bank of the Tees, at Middlesbrough (Yorkshire) for the establishment of new copper works and a byproduct plant.

One of the Union Corporation's principal interests now is the San Francisco Mines of Mexico, which has made remarkable progress. The operating profit for five months of the current financial year is £129,000, compared with £181,434 for twelve months to Sept. 30 last and £58,132 for the previous year.

Shareholders in Oroville Dredging Co. (Colombia) have had a rather rude shock, as, since W. A. Prichard's death, J. D. Hoffman has examined the property and is not in a position to confirm the estimates of yardage, owing to cavings and close timbering, the latter rendering sampling impossible. Earnings from the Pato mine are consequently to be applied in meeting Constancia financial requirements, instead of raising money on onerous terms. Oroville dividends are therefore suspended.

Granby Concentrator Not Yet Up to Capacity

The Granby company's new concentrator at present is turning out only 250,000 lb. of copper in the form of concentrate per month, but when it is tuned to capacity it is expected that it will produce 1,250,000 lb. The plant is divided into four units, which are being broken in one at the time.

Canadian Mining Companies See $300,000 Annual Tax Saving

New Budget Revises Tariff and Eliminates Sales Tax on Machinery and Supply—Explains Biggest Item

The saving to the mining industry of Canada due to the tariff revision and the elimination of the sales tax on mining machinery and explosives is estimated at nearly $300,000 annually. The figures for 1923 show total imports of mining machinery valued at $823,980, of which $756,332 came from the United States and only $67,648 from Britain. The duties paid were $218,166 under the general tariff and $10,114 under the preferential tariff. The drop in the preferential tariff from 15 to 10 per cent is a saving of about $3,371, and the decrease in the general tariff from 27½ to 20 per cent should lessen the cost by about $61,798.

The sales tax elimination on mining machinery; heretofore amounting to 6 per cent, means a saving of $49,438, and the wiping out of this tax on explosives will cheapen the supplies of this material by $163,800.

American Engineer, Traveling in Interior China, Thrilled at Meeting Old Friends

ARTHUR L. WALKER, professor of metallurgy, Columbia University, recently returned from a most interesting trip around the world. Traveling more than 45,000 miles, Professor Walker did not keep to the beaten track familiar to most tourists, but visited some out of the way spots remote from the usual highways of travel.

"While in China last December I went up the Yangtsze River," writes the professor to A. R. Watson, president of the Balbach Smelting & Refining Co., "to Hankow, a large manufacturing and shipping center about 600 miles from Shanghai. It is called by some the 'Chicago of China.' All merchandise and freight is handled and carried by coolies. Heavy loads and long hauls do not seem to worry these hardy men.

"At one place, I saw something you may be interested in hearing about. A long line of coolies were carrying heavy bars that looked familiar but very different from any of the other freight. On close inspection I found they were copper ingot bars and that these bars were branded 'N B C,' undoubtedly coming from your company's plant on Newark Bay. I felt as if I had run across some old friends. Considering the amount of your copper being transported, I should say there would be no dearth of 'cash' and 'coppers' in the provinces of Hupeh, Hunan and vicinity, for a long time to come."

British Active Developing Old Argenta Mines

The South African Construction Co., a British corporation, is developing the Ferdinand group of claims, near Argenta, Mont., which were very rich producers in the 60's. Ore was shipped from them to Corrine, Utah, by ox teams, and from there by rail to the coast, and from there by boat to Swansea, Wales, where it was smelted.

It is said that the work yielded a good profit at that time. In later years the ore was treated near Argenta, at the first smelter built in Montana.

Recent shipments from the property have been sent to the East Helena smelter, and returned a metal value of $61 per ton.

Many other properties in the district are being worked by leasers and prospectors.

Men You Should Know About

F. W. Bradley is at Kellogg, Idaho.

F. B. Weeks was recently in San Francisco.

Charles F. Rand has sailed for England and France.

W. H. Staver has returned from a five months' trip to Porto Rico.

Loomis, Suffern & Fernald announce the removal of their offices from 54 Wall St. to 50 Broad St., New York City.

Major Charles F. Williams is attending the Chemical Warfare Line and Staff School at Edgewood Arsenal, in Maryland.

F. J. McLain, assistant secretary-treasurer of the Quincy Mining Co., has returned to Michigan from New York City, where he spent the winter.

Philip R. Bradley has returned to San Francisco from a visit to Arizona and Idaho and will soon return to Juneau, Alaska.

Olaf Wenstrom, mining engineer of Boston, has been appointed on the board of directors of the Carson Hill Gold Mining Co.

Charles McCrea, Minister of Mines for the Province of Ontario, Canada, sailed on April 25 for England, to attend the forthcoming British Empire Exhibition.

A. D. Stevenot has resigned as manager of the Carson Hill property of the Carson Hill Gold Mining Co., California, and is succeeded by **R. C. Eisenhauer.**

R. M. Henderson, manager of the Wellington Mines Co., at Breckenridge, Colo., has been in Bellehelen, Nev., on inspection of the Bellehelen Merger Mines Co. operations.

Russell Scott, who recently completed his course at the Michigan College of Mines, at Houghton, Mich., has left for Ecuador, South America, to accept a mining engineering position.

C. B. Whitwell has been appointed plant manager in charge of the soapstone quarries, mill, and railroad, at Arrington, Va., for the Phoenix Stone Co., with offices at 111 Broadway, New York City.

Dr. Harry Mace Payne, consulting engineer of the American Mining Congress, delivered an address on "Industry and Citizenship" before the Raleigh, N. C., Chamber of Commerce on April 15.

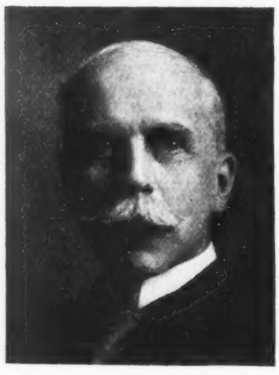
J. E. Perrault, Minister of Colonization, Mines, and Fisheries for Quebec, announces that he will soon visit the gold fields of Rouyn and Boischatel townships to study conditions as a guide to future legislation.

Walter Herd, chief mining engineer of the British Empire Steel Corporation, has returned from an extended visit to England and Scotland, where he has been making a close study of modern methods of coal mining.

Karl Eilers left New York on April 22 for Colorado and Nevada. Mining interests at Cripple Creek and at Eureka will engage his attention. He is accompanied to Cripple Creek by **L. F. Strobel,** consulting engineer.

Norman L. Warford, engineer for the Fuller-Lehigh Co., at Allentown, Pa., has arrived at Elisabethville, Belgian Congo, South Africa, where he will have charge of the construction of a smelter plant for the Fuller-Lehigh Co.

Dr. Frank D. Adams has tendered his resignation as dean of the faculty of applied science at McGill University, Montreal. He has been a member of the staff of the university for more than thirty-five years and has carried out much research work on geological problems in Canada. He is a member of numerous scientific societies. In 1913



Dr. Frank D. Adams

he was president of the International Congress of Geologists, and in 1914 was president of the Royal Society of Canada.

Robert H. Shields, of Houghton, Mich., president of Arcadian Consolidated, is being urged by his friends to enter the race for the Republican nomination for Congressman from the Twelfth Michigan district. Mr. Shields, has made no definite announcement of his intentions.

W. J. Uren, general manager and one of the receivers of the Seneca Copper Corporation, and **Fred R. Kennedy,** of New York, treasurer of the company, have arrived in the Michigan copper country from the East. Arrangements were made upon their arrival to finance the payroll of the company.

Emmet D. Boyle, former Governor of Nevada, but more recently mining engineer with headquarters in Reno, has accepted the position of mine manager with the Mason Valley Mines Co., near Yerington, Nevada, succeeding **William Koerner,** who leaves to take a position with the Magma Copper Co., at Superior, Ariz.

Morton Webber is spending a short vacation at Coronado, Calif., having returned from Morelos, Mexico, where he has been engaged in professional work for the last three months. He will soon visit the Las Chispas mine, at Sonora, Mexico, which property is controlled by the Minas Pedrazzini, for which company he is consulting engineer.

Cleveland O. Moss has returned to the United States from Brazil, where he has been employed the last three years as mining engineer for the Companhia Electro Metallurgica Brasileira of Ribeiras Poeto, and consulting engineer for the Servicos Reunidos of Victoria, Espirito Santo, and is now geologist for the Stratton Leasing Co. at Victor, Colo.

Dr. F. W. McNair, president of the Michigan College of Mines, Houghton, Mich., and a member of the board of investigation and co-ordination of the Society for the Promotion of Engineering Education, will attend a meeting of the board in New York City in May, the date of which soon will be set. Dr. McNair will have **W. E. Wickenden,** of New York, director of investigations for the board, as his guest for several days in June. Mr. Wickenden will visit the College of Mines and mines in the Michigan copper district.

H. I. Jensen, who a year or two ago retired from the Queensland Geological Survey, on which he had charge of oil prospecting, has lately gone to Coorong, in South Australia, to make a geological survey and report on behalf of the Central Coorong Oil Co., of Melbourne, Victoria, which has command of sufficient capital to drill for oil on its areas at Alfred Flat, in that state. Dr. Jensen has lately been engaged by the Australian Oil Corporation to examine promising prospecting areas in Queensland, Australia, and has recommended for boring a site on Forest Vale pastoral station 44 miles from the western township of Mitchell, in a northwesterly direction from Roma, and just outside the government reservation.

Obituary

W. P. Dunham, the original owner of the Ray Hercules mine, died in Los Angeles recently.

Edward Rockman, a mining engineer well known through the West for many years, died recently at El Paso, Tex. He was seventy-five years old.

William Ingham, chief engineer of the Rand Water Board, and recently elected president of the Scientific and Technical Club, Johannesburg, South Africa, died on March 7. He was fifty-six years old.

H. Carmichael, metallurgical chemist, of Boston, Mass., died recently. Dr. Carmichael was educated at Amherst and Göttingen, held several academic positions of importance, and at one time was assayer to the State of Maine.

John T. Morrow died in Croton, N. Y., on April 18, 1924. He was born in Bangor, Maine, in 1865, and was graduated with the degree of Mechanical Engineer from Lehigh University in 1889. Later he received the degree of Electrical Engineer. The first four years of his experience were with the Edison and General Electric companies. In 1893 he went to Great Falls, Mont., to the Boston and Montana Reduction Works, where he eventually became general superintendent. In the summer of 1903 he left Great Falls for Mexico, where he became general manager of the Greene Consolidated Copper Co. Among the positions that he held in succeeding years was that of chief engineer of the Marlin-Rockwell Leading Co., Wilmington, Del., and vice-president of the Dadson International Coal Corporation, of New York. At the time of his death he had an office as consulting engineer at 25 Church St., New York.

Societies, Addresses, and Reports

California Dredge Operators Visit Columbia Steel Plant

ON April 11 the California Gold Dredge Operators visited the plant of the Columbia Steel Corporation at Pittsburg, Calif., 40 miles from San Francisco. The visitors were taken through the plant, and at the evening meeting N. A. Becker, plant superintendent, told the history of the corporation.

The Columbia Steel Corporation was originally known as the Columbia Steel Co. Its first plant was a steel foundry at Portland, Ore., the work of which was restricted to small castings supplied to dredging companies. The need for heavier castings resulted in the establishment of another foundry for this work at Pittsburg, Calif. Open-hearth furnaces and a complete steel foundry for small and heavy work was built about eight years ago. A successful business was developed with the gold dredging industry.

When the war broke out, the company enlarged its business in steel castings. Almost the entire output was in navy and marine work. After the war it obtained orders for 12,600 tons of steel castings required for five new battleships. Later the company built a rolling mill to make reinforcing steel.

Up to this time, following the practice of other Coast plants, iron scrap had been used almost exclusively for the making of steel. The heavy drafts upon the local scrap market reduced the available supply and made the future supply uncertain. About this time D. H. Botsford succeeded in bringing to this company's attention certain coal and iron-ore deposits in Utah. An excellent coking coal and a high-grade iron ore could be made available by sufficient capital expenditure. As a result a reorganization of the Columbia Steel Co. was effected and the Columbia Steel Corporation was formed. W. E. Creed is president and the other members of the directorate are J. D. Grant, Herbert Fleischhacker, John S. Drum, and W. W. Crocker.

A $4,000,000 bond issue was successfully marketed. Later the Llewellyn Steel Co., of Los Angeles, was acquired and an enlarged program providing for a more diversified product was entered upon.

The company now controls three plants, at Portland, Pittsburg, and Los Angeles, respectively. It has erected a blast furnace and a byproduct coking plant at Provo, Utah, and has constructed railroads to its coal and iron properties. The blast furnace unit will be placed in operation in April, 1924. The plant at Provo is in a strategic position, as rail lines radiate from Salt Lake to Portland, San Francisco, and Los Angeles.

The establishment of a manufacturing business that has grown to importance enables the company to provide an outlet for its pig iron. The control of a pig-iron supply makes the company independent of the local scrap market and of foreign importation as well as importation from eastern districts. The advantages of the situation from a competitive standpoint are cheap and dependable power, low-priced fuel oil, modern installations, and favorable climatic conditions.

The importance of the Pacific Coast region as a consumer of iron and steel products is not well appreciated. The per-capita consumption of iron is relatively greater on the Pacific Coast than in other western localities. The region is in its constructive stage and its population is growing rapidly. The requirements of this population are varied, and necessarily there must be a constant inflow of manufactured products either from local or distant manufacturers.

The considerable development of hydro-electric power has stimulated manufacturing. As a result the Coast region is supplying more and more its immediate needs and developing regional markets.

The raw materials used are dolomite, limestone, iron ore, and fluorspar. Dolomite is supplied to the Pittsburg plant from Salinas, limestone from Alvarado, and iron ore from Shasta County. Firebrick for the construction and repair of reheating furnaces and for ingot molds is supplied by the Stockton Firebrick Co. Silica brick and chrome-magnetite brick for the open-hearth furnaces are supplied by the Harbison-Walker Refractories Co.

The Columbia Steel Corporation is an ambitious organization under excellent leadership and with substantial financing. It now occupies an important position in manufacturing and marketing steel products. The extensions under construction and the development of a source of pig iron should consolidate the position of the company and enable it to expand its markets and increase its regional importance.

Walker to Talk of His Trip Round the World

The last meeting of the New York Section of the A. I. M. E. for the present year will be held April 30, at the Harvard Club, 27 West 44th St., New York. The speaker will be Prof. Arthur L. Walker, professor of metallurgy at Columbia University. His subject will be "Modern and Ancient Engineering and Metallurgy as Observed During a Trip Around the World."

Ethics of Mining Engineers

The New York section of the Mining and Metallurgical Society of America had a dinner at the Harvard Club on April 16. The topic for the evening was Professional Ethics. Mr. Herbert G. Moulton, chairman of the New York section, presided. The subject was opened by Colonel Arthur S. Dwight, chairman of the Society's committee on ethics, and was followed up by Mr. J. E. Spurr; after which the matter was thrown open to general discussion.

The subject proved to be of great interest, and many definite and opposing opinions were offered in solution to the impersonal and sometimes hypothetical type cases which were submitted. Mr. Thomas H. Leggett, president of the Society, expressed his belief that there was a promising field of work for the Society for reaching a better common understanding as to the approximate standard of professional ethics which represents the general attitude of the best type of mining engineers.

Mining Symbolized in Float

The accompanying photograph shows the float that won first prize on Engineers' Day at the University of Illinois, which was April 4. Each engineering department entered a float. An effort was made by the students to typify coal mining, metal mining, and metallurgy. The front end of the float, viewed from the rear, would show a coal-mine drift with a car of coal emerging and a miner.

Illinois students' float typifies the mining industries

Recent Technical Publications

Reviews, Abstracts, and References

The Production and Use of Lead

Lead. By J. A. Smythe. Longmans, Green & Co., London and New York, 1923. Price $5.25.

The subtitle of this book on lead states that the volume covers "its occurrence in nature, the modes of its extraction, its properties and uses, with some account of its principal compounds." Its scope may be further indicated by a recital of the chapter headings, with the number of pages devoted to each subject: History of lead (24); Occurrence of lead: ores, minerals and localities (21); The chemistry of roasting and smelting (39); Extraction of lead in the reverberatory furnace and ore hearth (24); Extraction of lead in the b'ast furnace (37); The softening and desilverizing of lead (27); Cupellation or refining (18); Condensation of lead fume (11); Uses and properties of lead and its alloys (28); Compounds of lead —the oxides (17); The carbonates of lead—white lead (32); Other compounds of lead (28); and Lead poisoning (7).

The author has made a readable book and one that covers the subjects enumerated satisfactorily, considering the number of pages allotted. The part of the book devoted to the uses of lead is particularly valuable. Many of the mining and metallurgical data are presented from the European standpoint, and American readers will find little that is illuminating regarding American practice. That part devoted to reverberatory furnaces, for instance, will read like ancient history to American metallurgists, for this type of furnace, we believe, is totally extinct in this country for the smelting of lead ores. Most of the information given seems to be accurate, though occasionally we run on a statement with which we cannot agree, as "The Broken Hill deposits in New South Wales are among the most important in the world. It is estimated that 27 per cent of the world's production comes from these mines." The author's estimator must have been working overtime, or else a typographical error was made and it was intended to say 7.2 per cent.

The volume is one of a series of monographs on industrial chemistry, and the author therefore gives particular attention to the chemical reactions involved in the production and use of lead and its compounds. The chapters on the compounds of lead are particularly good, practically no combination of lead with other e'ements being overlooked. Another compound of lead that has come into some prominence since the book was written is lead tetraethyl, which recent tests have indicated will prove a valuable additive agent to motor gasoline, to increase power and prevent knocking of the engine.

Though the book was written by an Englishman and published by a British publisher, it was printed and bound in Germany. Evidently a cheap job was what the publishers were after, and this is exactly what they got.

E. H. ROBIE.

Metal Statistics, 1924. Published by the American Metal Market, New York. Price $1.

The 1924 edition of this useful volume, containing data for 1923 and preceding years, has just been published. As usual, it gives production, consumption, prices, imports, exports, grades, and similar information regarding all the more common metals and metal products. The prices for most of the metals are those published in the daily editions of *The American Metal Market.* The book is well and favorably known to the trade as a reliable and handy reference book.

Handbook of British Guiana. 1922. Edited by William Francis and John Mullin. Obtainable on request from the Committee of Correspondence and Exhibitions, Royal Agricultural and Commercial Society, Georgetown, British Guiana.

This bound book of 300 pages is an advertisement of British Guiana, and tells all about its resources, industries, form of government, and other matters that would interest an intending visitor or investor. It is well illustrated and includes a colored map of the country.

Canadian Geology—Memoir No. 135 of the Canadian Geological Survey, Ottawa, Canada, by W. A. Johnston, is an 88-page bulletin on the "Geology of the Fraser River Delta Map-area," in British Columbia. A large map, in colors, of Vancouver and the country to the south and east is included. The memoir is obtainable on request to the Survey.

Canadian Mining—The Report of the Canadian Department of Mines for the fiscal year ending March 31, 1923, has been issued as a bulletin of 58 pages. It details briefly the government's activities in the mining industries during the year. Price 5c. from the Department of Mines, Ottawa, Ont.

Mexican Mineral Resources—"Mexico, the Treasure Land of the World," is the title of a 20-page booklet advertising the mineral resources of our southern neighbor. The most important producing fields of each mineral are given. Copies may be obtained on request from Alberto Mascarenas, Consul General of Mexico, New York City.

Alaskan Maps—The U. S. Geological Survey has published a new relief map of Alaska, 40 miles to the inch, size 30x50 in. The water and glaciers are shown in blue, the relief is shown in brown, and the names and man-made features appear in black. The map is the work of R. H. Sargent and John H. Renshawe, and is known as Map D, obtainable for 50c. from the Survey, at Washington, D. C. Map E, issued last year, sells for 25c.; it shows more of the geographic names but not the relief.

Early Days on the Comstock Lode

From '49 to '83 in California and Nevada. Chapters in the life of George Thomas Marye, a Pioneer of '49. By George Thomas Marye, Jr. A. M. Robertson, San Francisco. Price $2.50.

The author of this interesting account of early western history will be remembered as the United States Ambassador to Russia in the early days of the World War, having previously been associated with his father, the subject of this narrative, in banking enterprise in San Francisco and Virginia City, Nev. "In 1849," we read, "the story of Marshall's discovery of gold in the far-off territory of California had spread from the distant shores of the Pacific to the Atlantic states, and the eyes of ambitious and adventurous men were beginning to be turned with ardent and longing glances towards the new El Dorado. Marye was one of the earliest to feel the attraction, and he set out for California (from his home in Baltimore) by way of the Isthmus in the spring of 1849; and after an anxious and trying trip, arrived in San Francisco on board the steamer 'Panama,' in the month of August of that eventful year. He was then thirty-one years of age, in the full vigor of early manhood, and he at once set himself to work in the development of San Francisco, and of the state. He constructed wharves and buildings, and took a wide interest in land values and transactions."

Followed sundry real-estate transactions and participation in the stirring events that characterized early history at Virginia City and on the Comstock, where a fortune was quickly accumulated by prompt action in real estate. This phase of the history reminds us of the first financial success of Cecil Rhodes on the diamond fields of South Africa. Life at Virginia City is pictured by the narrator in a manner that gives one a vivid insight into the happenings of the days that preceded and accompanied the development of the famous Lode. "The early profits," we read, "such as they were, went very unevenly to a good many different people, but least of all to the first discoverers; and the honor of the discovery has not been accredited either to the men who first suspected the presence of the vein, or to those who did the first work on the ground, or to the one who made the first informal location on the site of the great ledge. The two brothers, Hosea and Allen Grosh, of Pennsylvania, from their knowledge of the surface deposits in Gold Canyon and their investigation of the surrounding country, were the first to assert that there should be deeper and more extensive deposits in the neighborhood of the mountain they knew as Sun Peak. They both died from hardship and exposure before their well-reasoned anticipations were verified by later developments. The first work on the surface of the vein was done by Peter O'Riley and Patrick McLaughlin, though of course in entire ignorance of what was beneath and around them, and the first attempt to

make even an informal mining location there was made by James Finney, an old miner from the State of Virginia. The names of those men, except perhaps in the public schools of Virginia City, are entirely unknown to the general public in connection with the mines of Washoe. The lode received its name from Henry Comstock, a Canadian, who acquired in some way an interest in the claim of O'Riley and McLaughlin, though he does not seem to have done any work there; and the lode was called after him with no greater reason or justice than the Americas were given the name of Americo Vespucci. James Finney, who was generally known as 'Old Virginny,' and who was held in high esteem by his associates and acquaintances, has had his memory perpetuated in the name of Virginia City."

The introduction of the patio process on the Ophir property, in Washoe Valley, came about thus, according to the author: " . . . the directors of the Ophir made overtures to Walter W. Palmer, a mining man who had charge of a mine in Mexico and who was temporarily in San Francisco . . . While negotiations were pending he said, 'Gentlemen, my terms are a salary of $25,000 a year . . . you must reach a conclusion within forty-eight hours.' A salary of $25,000 was a very large one . . . but the directors thought that Palmer knew more about quartz mining and reducing ores than anyone else in California or Nevada, and they accepted his terms and elected him superintendent. At the mine where he had worked in Mexico they used what was called the patio process of amalgamating silver; and after he came to the Comstock he spent most of his time at the Ophir mill, in Washoe Valley, trying to improve that process by driving horses through the pulp of crushed ore, quicksilver, salt, copper and water, saying that the warmth of the horses' feet was necessary to make the amalgamating process complete. The directors as well as their superintendent were the butt of a good deal of ridicule, and when his term of employment came to an end it was not renewed."

The square-set method of timbering underground, we learn, originated with Philip Deidesheimer, a German engineer from Hesse-Darmstadt, who was superintendent of the Mexican mine. The evanescence of fame prompts the author to remark that "It seems curious at first blush that neither history nor tradition in Virginia City furnishes any information about the men after whom some of the most important mines were named. The Best & Belcher, the Gould & Curry, the Hale & Norcross and the Savage were all prominent mines . . . yet no one knew anything about the men whose names they bore. That seems strange at first, but when we reflect about it, it becomes less so. The early prospectors were always poor men of roving adventurous disposition and character, and when they had made their locations they soon realized that they had not the money—and probably in some instances the patience—to develop their claims; so they promptly sold them for such small renumeration as they could get, and drifted on to other fields to make new discoveries."

The mines, we learn, were first organized and shares issued according to the number of feet in the claim on the Lode. "In some instances there were several shares to a foot, as in the Gould & Curry, which had four shares to a foot." The transition from feet to shares occurred in 1867 on the San Francisco Stock Exchange. Marye went to Virginia City in 1869, to take charge of the local house of the firm of Marye & Cahill, a branch of which he subsequently became sole owner. Between 1873 and 1879—the Great Bonanza period—he transacted at least half the brokerage business being done in the city. A biographical sketch, forming the last chapter, shows that the chronicler of the narrative, the youngest son, was sent to Cambridge University in 1864, where, it may be added, he studied law, graduating with high honors.

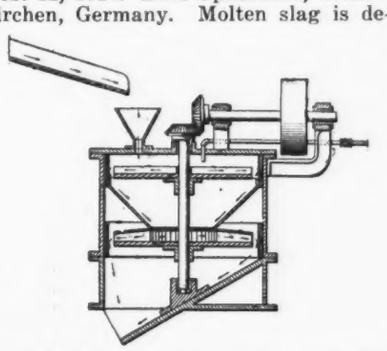
The book, which bears evidence of the author's literary craftsmanship, is replete with personal references, which will be appreciated by those who are interested in intimate details of the early history of San Francisco and Virginia City. In printing, binding, and general appearance it brings credit to a Western publishing house.

A. W. ALLEN.

Patents

Lead Refining—Reissues Nos. 15,750 and 15,751, Jan. 22, 1924. Henry Harris, London, England. A process of dezincking lead, consisting in bringing the molten lead into intimate contact with a mixture of caustic alkali and alkali chloride. The temperature is maintained below that at which any appreciable amount of alkali metal passes permanently into the lead. The process covered by these patents has received considerable notice as the Harris process, and is being sponsored in this country by the International Process & Engineering Corporation, 42 Broadway, New York City.

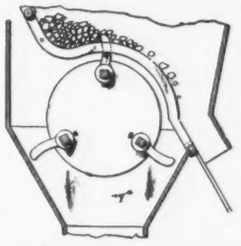
Slag Granulation—No. 1,483,241. Feb. 12, 1924. Emil Opderbeck, Gelsenkirchen, Germany. Molten slag is de-



livered through a hopper to a rotating table on which a current of water also flows. The slag is granulated and thrown to the periphery where it strikes against an abutment and falls out as dry slag sand.

Tungsten Separation—No. 1,481,697. Jan. 22, 1924. W. H. Dyson, Normandy, near Guildford, and Leslie Aitchison, Birmingham, England. Oxidized metals of the tungsten group are separated from other metalliferous materials by heating the whole in a halogen atmosphere, out of contact with any carbon or sulphur-bearing reducing agent, at such a temperature as to cause the conversion of the oxide of the tungsten-group metal to the halogen derivative. This is then volatilized.

Ore-screening Device—No. 1,485,872. March 4, 1924. Gus Nelson, Douglas, Ariz. An ore-screening apparatus having spaced parallel bars, with rotating



agitating elements passing between them to facilitate the passage of the ore over the bars.

Amalgamator—No. 1,481,311. Jan. 22, 1924. W. H. Appleton, Spokane, Wash., assignor to Western Metals Co., Spokane, Wash. A centrifugal amalgamator for gold and silver ores, specially designed to prevent flouring of the mercury.

Electrolytic Separator—No. 1,481,751. Jan. 22, 1924. W. A. Sharpe, Denver. An electrolytic ore separator comprising several electrolytic cells, a cathode in each cell, and an endless belt conveyor as anode.

Fume Precipitation—No. 1,481,970. Jan. 29, 1924. H. V. Welch, Los Angeles, assignor to International Precipitation Co., Los Angeles. A further variation in the precipitation of fume by the Cottrell process.

Vanadium Recovery—No. 1,482,276. Jan. 29, 1924. W. E. Stokes, Rockville Center, N. Y., assignor to United States Processes, Inc., New York City. In the recovery of vanadium, a cold-water soluble vanadium compound relatively insoluble in hot water is first formed, afterward being precipitated by hot water.

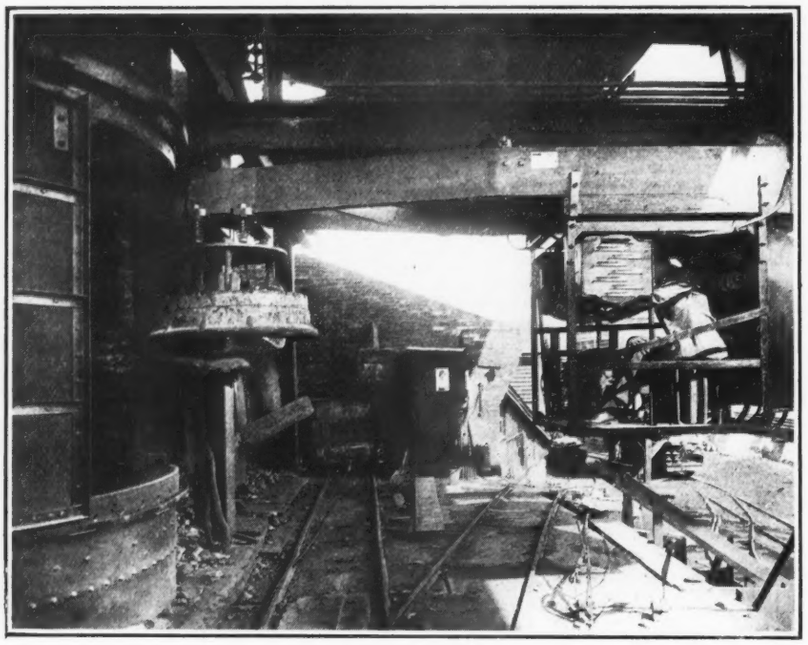
Electrometallurgy — No. 1,487,275. March 18, 1924. C. A. Scharschu, Pittsfield, Mass., assignor to General Electric Co., Schenectady, N. Y. A metal containing slag particles is subjected, while in a molten state, to a periodically varying magnetic field adapted to cause the slag particles to rise to the surface.

Complex-ore Treatment—No. 1,487,285. March 18, 1924. E. A. Taylor and G. A. Keep, Cleveland, Ohio, assignors to the Grasselli Chemical Co., Cleveland. Zinc sulphide is separated from ground complex sulphide ores by treating them with hot sulphuric acid, in amount not less than is chemically equivalent to the zinc content of the ore.

Placer Gold—No. 1,489,975. April 8, 1924. C. G. Bluhm, Fruita, Colo. A classifier adapted to placer mining, consisting of a spiral conveyor operating in a perforated cylindrical housing.

No. 1,490,016. April 8, 1924. R. D. Mackenzie, New Westminster, B. C. A sluice for gold recovery, with a suction intake.

New Machinery and Inventions



This machine brings the iron to the cupola on a magnet, and the coke and flux in a drop-bottom bucket. The charges are pushed in by the cantilever arm, lowered gently and deposited evenly

Cupola Charging Made Easy by New Machine

A new charging hoist has been designed by the P. H. & F. M. Roots Co., Connersville, Ind., to serve primarily as the principal unit of a new and better method of charging foundry cupolas. This hoist brings the iron to the cupola on a magnet, and the coke and flux in a drop-bottom bucket. The charges are pushed into the cupola by the cantilever arm, lowered gently, and deposited evenly over the full area of the cupola.

The hoist shown in the accompanying photograph was recently placed in service at the plant of Davies & Thomas Co., at Catasauqua, Pa. The charging hoist consists of a rigid semi-steel frame casting hung from two cast-steel traveling trucks which run on the lower web of a standard I-beam. Bolted to the hoist frame is a cast-steel cantilever arm, from the end of which hangs a magnet. The forward truck carries the travel gearing, which is positively driven from a standard, fully inclosed, crane-type motor mounted on the hoist frame. All gears are cut from solid blanks, the pinions being forged steel and the gears cast semi-steel. All four wheels are driven, and the speed of travel is 300 to 350 ft. per minute. The rear trailer truck is built with up-thrust roller to maintain balance when the charging arm is completely loaded.

The entire hoisting mechanism is inclosed in the frame and charging arm castings, where it is protected from heat, dust, and gases from the cupola. Despite this, all parts are accessible.

The hoisting drum and sheaves are fully machined from semi-steel castings and are grooved to coil the hoist ropes and magnet cables at the same speed without overlapping. The drum is positively driven through spur gearing by an oversize hoist motor. The hoisting speed is 25 to 30 ft. per minute. The shafting, of high-quality roller-bearing steel, is oversize, to insure great strength and smooth operation while running.

Large-size Hyatt heavy-duty roller bearings are used throughout except in the motor. Thus friction and wear are practically eliminated. The positive, high-pressure Alemite system of lubrication is furnished for all except motor bearings.

Hoist ropes are of flexible plow steel to prevent excessive wear over sheaves. The magnet is of the mill type and is fire and water proof. Of special interest is the magnet hook, which telescopes into the cantilever arm, thus protecting sheaves, ropes, and cables from the cupola heat and gases, and at the same time preventing the load from swinging while it is being moved into the cupola.

The brake on the hoist motor will hold the full load torque of the motor and is mounted directly on motor bracket.

A Centrifugal Compressor in New Design

A new design of single-stage centrifugal compressor, whose principal features are strong construction, accessibility, improved pressure characteristics, and higher efficiencies, has been perfected by the General Electric Co. and is now on the market. It comes in two types, single and double inlet. The single-inlet type is designed for the more general use, the double-inlet variety being necessary only when the ratio of impeller inlet and exit diameter reaches a design value demanding the use of the double inlet to function properly.

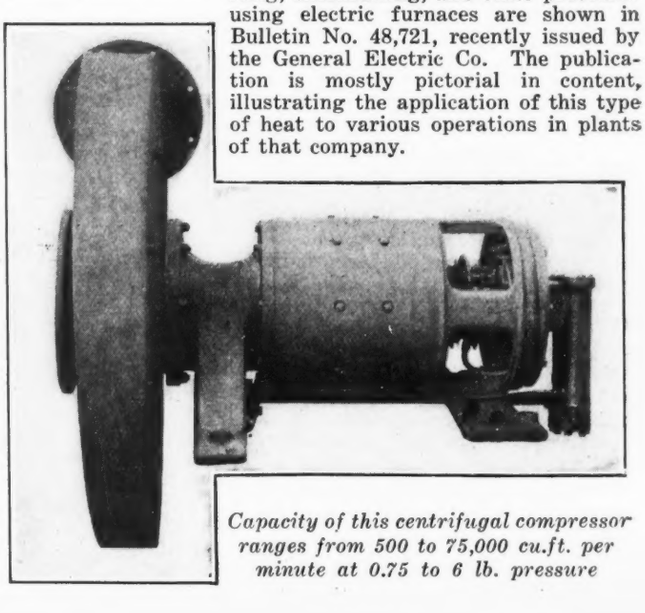
The machines are available in capacities from 500 to 75,000 cu.ft. per minute at 0.75 to 6 lb. pressure. They are provided with oil pumps designed to furnish plenty of oil to the bearings. Capped holes in the tops of bearing linings are eliminated, preventing the entry of dust into the lubricating system. A heavy hinged cast-iron cover is provided on one side of the middle bearing bracket, which may be lifted to inspect the return flow of oil from the lubricating system.

The pulsation point of these machines occurs at very light loads. The efficiency curves are broad, thus showing an improvement over older types. The no-load power consumption of the new machine is between 60 and 70 per cent of that required for machines of previous design.

Outstanding manufacturing details include bearing supports of strong construction, the casing being attached to the bearing bracket by a flange. The weight of the casing, although not great, has been distributed in such a manner as to make the unit unusually strong mechanically. This is made possible by the use of steel plates varying from ⅜ to 1¼ in. in thickness in the various parts of the compressor.

A Recent Trade Catalog

Electric Furnaces. Annealing of castings and wire, heat treating, calorizing, sherardizing, and other processes using electric furnaces are shown in Bulletin No. 48,721, recently issued by the General Electric Co. The publication is mostly pictorial in content, illustrating the application of this type of heat to various operations in plants of that company.



Capacity of this centrifugal compressor ranges from 500 to 75,000 cu.ft. per minute at 0.75 to 6 lb. pressure

THE MARKET REPORT

Daily Prices of Metals

Apr.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
17	13.25	48.75	49.25	8.00@8.25	7.75	6.05
18	13.25	48.75	49.25	7.90@8.25	7.75	6.05
19	13.125@13.25	48.375	48.875	7.90@8.25	7.75	6.10
21	13.125@13.25	48.75	49.25	7.90@8.25	7.70@7.75	6.10
22	13.125@13.25	49.125	49.625	7.90@8.25	7.70@7.75	6.125@6.15
23	13.25	49.25	49.75	7.90@8.25	7.70@7.75	6.125@6.15
Av.	13.219	48.833	49.333	8.083	7.738	6.096

*These prices correspond to the following quotations for copper delivered: April 17th, and 18th, 13.50c.; 19th, 21st, and 22d, 13.375@13.50c.; 23d, 13.50c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the narmal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Apr.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
17	64⅝	65½	70¼	247¼	246¾	32¼	30⅜	32⅜	32⅜
18	...	...	...	....	....	...	...	...	...
21	...	...	...	....	....	...	...	...	...
22	64⅝	65⅜	70½	247¾	247¾	32¾	31⅛	32⅝	32⅜
23	64⅜	65¼	70¼	248½	248½	32⅞	31	32⅝	32½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver		Gold London	Apr.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
17	4.34⅝	64½	33 5/16	94s 11d	21	4.37⅛	64¾	....	.....
18	4.34⅞	64½	....	.....	22	4.38⅛	64⅝	33⅛	94s 2d
19	4.37¾	64⅜	....	.....	23	4.39	64¾	33⅛	93s 10d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, April 23, 1924

Copper

Domestic sales of copper have not been quite so good as for the week which ended last Wednesday, but nevertheless the market has been far from dead. Throughout the week until today, most producers were quoting 13½c. delivered, especially those that have a refining-in-transit freight rate. Today, the general asking level is more nearly 13⅝c., but sales at the higher level have been confined to an occasional carload. There is no doubt that the market has been influenced by the favorable reception accorded the Dawes report, which has resulted in higher rates on foreign exchange and a better feeling in the European metal markets. Sales of copper for export have not been particularly large, but prices have held well and there does not seem to be any particular pressure from this side to depress prices by insistent selling. Yesterday and today, export copper brought from 13.45@13.55c., f.a.s., so there was little reason for producers to sell below 13⅝c. delivered for domestic business unless they were anxious to sell in larger lots than is possible abroad. Unfortunately, this is exactly what happened on Saturday, Monday, and Tuesday, however. Two or three large orders were in the market, but the potential buyers refused to be interested at any figure over 13⅜c. delivered. They were not able to book their full requirements at that level, but one or two producers availed themselves of the opportunity to dispose of round lots even at this inside price. A great deal of secrecy has attended these sales.

The electrical industry, including wire, telephone, and telegraph companies, seems to have been responsible for most of the business during the last week or two.

Forward copper is obtainable for approximately the same prices as are asked for near-by. Some companies are buying almost entirely for shipment within a month, apparently counting on a general weakening of the commodity price level to prevent the price of copper advancing; others are buying ahead, feeling that fundamental conditions are so good in the copper industry that higher prices are warranted.

Lead

The official contract price of the American Smelting & Refining Co. continues at 8.25c., New York. Sales at the lower levels of 7.90@8c. have, however, been common, and the total volume of business has been somewhat greater than last week. One prominent seller reports that in the last two weeks he has not had an order for shipment later than a month from the date of sale. Everyone apparently wants spot or prompt lead that wants the metal at all. Most orders are for tonnages running from carloads up to 200 or 300 tons. Sales of lead at 7.90c., New York, were first reported about ten days ago, and since then nothing lower than this figure has been heard with the exception of one large purchase made about a week ago; the decline in the market, therefore, seems to have been arrested for the time being. Corroding grades are in limited supply and have been sold at 8.10c., New York.

Most producers in the Middle West are quoting at 7.75c. St. Louis, and report a quiet market at that level. Slight concessions have been made in certain instances, chiefly by dealers, but the low range of 7.65c. reported in the press seems to be extreme.

A feature of the market during the week has been the sale of one lot of lead for July shipment at 8c. New York. Few sellers or buyers are willing to commit themselves so far ahead with the present state of the lead market.

Zinc

The zinc market has been inactive all week, particularly in the last two days. With unchanged prices in London and improved sterling exchange, conditions for export sales have improved slightly, and as there has been little forced selling, the quotation is up about 10 points

over that of a week ago, bringing the price to 6.125@6.15c. Production has been cut to some extent, as there is little or no incentive for smelters to operate at present ore and metal prices. High-grade is unchanged at 8@8¼c. delivered.

Tin

The tin market has been quieter than usual, with practically no sales while the London market was closed. The price quoted on April 18 is entirely nominal. With the recent arrivals, the premium on spot tin has disappeared in the last day or two, spot and forward tin being quoted at the same price. Spot tin is expected to be scarce again in May, however.

Arrivals so far in April totaled 7,115 long tons.

Circulation Statement

The stock of money in the United States April 1 was as follows: Gold coin and bullion, $4,368,156,633; standard silver dollars, $500,369,769; subsidiary silver, $277,542,755; United States notes, $346,681,016; Federal Reserve notes, $2,476,245,570; Federal Reserve Bank notes, $12,172,170; National Bank notes, $776,334,042; total, $8,757,501,955. In circulation per capita, $42.85. During March the stock of gold increased by $30,000,000 and the outstanding notes decreased by $69,000,000.

Silver

Since the resumption of business after the Easter holidays the market appears steady at slightly higher prices in New York, due chiefly to reports of some Continental buying. India seems reluctant to enter the market at the present level.

Mexican Dollars—April 17th, 49¼; 18th, 49¼; 19th, 49¼; 21st, 49⅜; 22d, 49¼; 23d, 49⅜.

Foreign Exchange

All European exchanges have been stronger, reflecting progress in the settlement of the post-war muddle. On Tuesday, April 22, closing cable quotations on francs were 6.775c.; lire, 4.495c.; and Canadian dollars, 1⅜ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28@29c. per lb.; 98 per cent, 27@28c. London, £115 per long ton.

Antimony—Per lb.
Chinese and Japanese brands, 9⅞@10c.
W. C. C. brand, 12½c.
Cookson's "C" grade, 12½@13c.
Chinese needle, lump, nominal, 8½@9c.

Bismuth—$2.40@$2.45 per lb. London, 10s.

Cadmium—60c. per lb. London, 2s. 3d.

Cobalt—$2.50@$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—27c. per lb. for 99 per cent virgin metal. London, £130 long ton.

Osmiridium—Crude, $58.50 per oz.

Palladium—$83 per oz. Crude, $60 per oz.

Platinum:
Refined, $115.
Crude, $106@$108 per oz.
Market very quiet.

Quicksilver—$75@$77 per 75-lb. flask. San Francisco wires $72.35. London £14.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten** are unchanged from prices given April 5.

Metallic Ores

Chrome—$19@$22, depending upon grade and source. Nominal.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports:
Old Range, bessemer, 55 per cent iron, $5.65.
Mesabi, bessemer, 55 per cent iron, $5.40.
Old Range, non-bessemer, 51½ per cent iron, $4.90.
Mesabi, non-bessemer, 51½ per cent iron, $4.75.

Manganese—44@46c. per long ton unit, seaport, c.i.f. Nominal.

Molybdenum—80c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—Per unit, N. Y.
High-grade wolframite, $9@$9.25.
High-grade scheelite, $9.25.
Ordinary grades, $8.60@$8.75.

Magnetite, Tantalum, and **Vanadium** are unchanged from April 5 quotations.

Zinc and Lead Ore Markets

Joplin, Mo., April 19—Zinc blende, per ton, high, $42; basis 60 per cent zinc, premium, $39; Prime Western, $38; fines and slimes, $37@$36; average settling price, all zinc ore, $37.92.

Lead, high, $121.95; offering basis 80 per cent lead, $95; average settling price, all lead, $113.51 per ton.

Buying is in progress at 5 o'clock, sellers declining to accept the lower offerings until mid to late afternoon. The total tonnage that will be contracted for is not ascertainable. Some buyers decline to meet the $38 basis price, and one is reported offering only $36.

Lead is unchanged from last week. Shipments are still being made on the basis price current last month.

It is reported that miners are organizing a union, something never successfully accomplished here in former years, and little is known to what extent the movement is proving successful at this time.

Platteville, Wis., April 19—Blende, basis 60 per cent zinc, $42 to $43.50 per ton. Lead, basis 80 per cent lead, $90 per ton. Shipments for the week: Blende, 454 tons; lead, 40 tons. Shipments for the year: Blende, 7,162; lead, 272 tons. Shipments for the week to separating plants, 1,248 tons blende.

Non-Metallic Minerals

Asbestos:
Crude No. 1—$300@$400.
Crude No. 2—$175@$225.
Spinning fibers—$90@$150.
Magnesia and compressed sheet fibers—$60@$90.
Shingle stock—$50@$70.
Paper stock—$32.50@$40.
Cement stock—$20@$25.
Floats—$7@$9.
All per short ton, f.o.b. mines, Quebec, tax and bags included.

Bauxite—American, f.o.b. shipping point per gross ton:
Crushed and dried, $5.50@$8.75.
Pulverized and dried, $12@$14.
Calcined, crushed, $20.
Foreign, per metric ton c.i.f.:
French, 5 per cent SiO_2, $5@$6.50.
Dalmatian, low SiO_2, $6.50@$7.50.
Other grades, $6.

Feldspar—per long ton.
In *North Carolina*
No. 1 crude, $6.50@$7.50.
No. 2 crude, $4.50@$5.
In *Tennessee* per net ton
No. 1 ground, $15.32@$21.
Inferior grades, $11@$16.

Wide range is caused by difference in quality of material and wide difference in manufacture or fineness of grinding.

Barytes, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Phosphate, Pumice, Pyrites, Rutile, Silica, Sulphur, Talc, Tripoli and **Zircon** are unchanged from April 5 prices.

Mineral Products

Arsenious Oxide (white arsenic)—11c. per lb. Market stagnant.

Copper Sulphate—4.90@5c. per lb. Demand recently improved.

Potassium Sulphate, Sodium Sulphate, Sodium Nitrate and **Zinc Oxide** are unchanged from the April 5 prices.

Ferro-Alloys

Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from the prices given in the April 5 issue.

Metal Products

Copper—Sheets, 21⅜c. base; wire, 15⅞c.

Lead Sheets — Cut, 12.25c.; full, 12c. per lb.

Nickel Silver—18 per cent Grade A sheets, 27½c.

Yellow Metal—Dimension sheets, 18⅜c.; rods, 15⅜c.

Zinc Sheets—Base price, $9.75 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the April 5 prices.

The Iron Trade

Pittsburgh, April 22, 1924

Prices are weak in most finished steel lines, rails, pipe, and tin plate being firm. In bars, shapes, and plates 2.30c. is approximately the highest price asked. It is shaded on particularly attractive orders and is disregarded by eastern mills generally.

Pig Iron—The market remains stagnant. Recognizing that recent quotations on bessemer and foundry have been nominal, furnaces have reduced asking prices 50c. The market is now quotable at $22.50 for bessemer, $21 for basic and $21.50 for foundry and malleable, f.o.b. Valley furnaces. No sales of importance are reported.

Connellsville Coke — Spot furnace, $3.60@$4; $4.75@$5.25 for foundry.

Current Prices of Mine Materials and Supplies

RISE AND FALL OF THE MARKET

Steel structurals $2.25@$2.40 per 100 lb., Pittsburgh; plates $2.20@$2.40. St. Louis shows a rise of 25c. per 100 lb. in No. 28 galv. and black sheets. The fir timber situation is one of weakness in prices with production above normal, particularly in Denver and Seattle districts. Yellow pine mill stocks are fairly large, prices show no sign of softening. Explosives market shows little change. Steam and water hose prices tending upward.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.90@3.00	$4.10	$4.00	$5.00	$4.34
Black					
No. 28	3.85	5.00	4.85	5.80	4.85
Galvanized					
No. 28	$4.90@5.00	6.00	5.85	6.50	5.85

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	.....	$43.00
Standard openhearth rails	43.00	43.00	$43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$3.00@3.15	$3.15	$3.00	$3.85	$4.70	$3.72
Track bolts	4.00@4.25	4.00@4.50	4.00	3.90	5.95	4.57
Standard section angle bars	2.75	2.75	2.75	3.45	4.00	3.20

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.25@2.40	$3.00	$3.64	$4.40	$3.45	$3.30	$3.60
Channel, 3 to 15 in.	2.25@2.40	3.00	3.64	4.40	3.45	3.30	3.60
Angles, 3 to 6 in., ¼ in. thick	2.25@2.40	3.00	3.64	4.40	3.45	3.30	3.60
Tees, 3 in. and larger	2.25@2.40	3.00	3.64	4.40	3.50	3.30	3.60
Plates	2.20@2.40	3.00	3.64	4.40	3.45	3.30	3.60

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Hercules red strand, all constructions	20%
Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%

	New York	Cleveland	Chicago
Drill Rod (from list)	55@60%	40@55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
BUTT WELD	½ to 3	62	50½	¼ to ½	30	13
LAP WELD	2½ to 6	59	47½	3 to 6	28	13

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	44%	47%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$61.60@63.60	$57.50	$48.00	$57.20@60.20	$54.60	$60.00

Nuts—	New York	Cleveland	Chicago
Hot pressed, sq., per 100 lb. Off list	$1.00	$3.50	$3.50
Cold punched, sq., per 100 lb. Off list	1.00	3.50	3.50

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1179	$0.1314	$0.064	$0.125	$0.078	$0.108	.....
6x12x12	.1769	.1971	.088	.....	.106	.156	.....
8x12x12	.2211	.2463	.12	.215	.14	.244	$0.1968

MACHINE BOLTS—	New York	Cleveland	Chicago
1½ and 1¼x3 in. up to 12 in.	15 %	50—5%	50%

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers in yards at San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$35.00	$36.00	$37.00	$40.00
3x6 and 8	35.00	36.00	37.00	40.00
4x4-6 and 8	35.00	36.00	37.00	40.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	$46.00	$47.00	$42.00	$44.00
3x10 to 10x10	51.00	52.00	47.00	50.00
3x12 to 12x12	58.00	59.00	55.00	57.00

Other Cities	8 x 8-In. x 20 Ft. and Under Pine	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under Pine	Fir
Boston	$58.00	$68.00	$52.00	$52.00	$75.00	$90.00
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Denver	.....	40.75	40.75	40.75	.....	41.75
Minneapolis	42.00	42.75	40.00	.....	45.10	43.75
Kansas City	43.50	48.50	.....	.....	54.50	49.50
Birmingham	25@28	.....	.....	.....	29@32	.....

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.00	$3.80	$4.15	$4.55	$3.34	$4.95
Cut	3.15@3.25	4.45	5.25	5.75	3.59	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
NewYork, del. by truck	$2.50@2.60	$2.50@2.60	$2.70@2.80
Chicago, f.o.b.	2.20	2.20	2.20
Cleveland, f.o.b.	2.39	2.39	2.46

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	280-lb.net Common
New York	$18.20	$13.10	$3.75	$3.00@$3.25
San Francisco	22.00	.....	.....	(180-lb net) 2.10

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$0.95	$1.13	$0.94	$1.15

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Current	Dry 1 Yr. Ago	In Oil Current	In Oil 1 Yr. Ago
Red	15.00	14.25	16.50	15.75
White	15.00	14.25	15.00	14.25

HOSE—

	Fire	50-Ft. Lengths
Underwriters' 2½-in. coupled		61c per ft.

	Air—Best Grade 3 ply	Air—Best Grade 4 ply
¾-in., per ft.	$0.36	$0.44½

Steam—Discounts from List

First grade	Second grade	Third grade
30–5%	40%	40–5%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition	50%	Best grade	50–5%

LEATHER BELTING—List price, 2c. per sq. in. per ply.

Grade	Discount from list
Medium	40–2½%
Heavy	30–5%

RAWHIDE LACING—For cut, best grade, 45–5%, 2nd grade, 55%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 45–5%; sides, 41c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Rubber sheet	.45
Rubber sheet, wire insertion	.70

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.23½	New Orleans	$0.17½
New York	.19½	Seattle	.18
Chicago	.18	San Francisco	.17

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.2125	.2325
New Orleans	.195	.22
San Francisco	.1625	.1925

FLOTATION OILS—All prices are per gal. in carload lots; 50-gal. bbls., gross weight 500 lbs.

Pine oil, steam dist., f.o.b. New York	$0.65
Pine tar oil, ref. f.o.b. New York	.50

CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb.	$0.09½
Litharge, delivered New York, casks, 500 lb. lots, per 100 lb.	11.50
Sodium cyanide, 220 lb. single case lots, f.o.b. New York, per lb.	.19@.22

Company Reports

Phelps Dodge Corporation

A report of the operations of the Phelps Dodge Corporation for 1923 shows an income of $525,577.55 before depletion.

Consolidated Income Account

Income		
Sales of metals, fuel, and merchandise	$29,445,618.82	
Income from investments, and miscellaneous earnings	290,001.49	$29,735,620.31
Expenses		
Cost of metals, fuel, and merchandise	$26 431,055.11	
Provision for depreciation	1,946,055.29	
Interest	832,932.36	29,210,042.76
Income for 1923, before depletion		$525,577.55

Consolidated Balance Sheet Dec. 31, 1923

Assets

Fixed		$197,329,733.04
Current		32,368,991.48
		$229,698,724.52

Liabilities

Capital stock—authorized and issued—500,000 shares at $100		$50,000,000.00
Deferred—$316,530 outstanding preference stock of the Arizona Copper Co., Ltd.		1,540,446.00
Current		21,038,684.28
Reserves		
Depletion	$54,366,357.12	
Depreciation	15,876,706.52	70,243,063.64
Surplus		
Balance Dec. 31, 1923	92,760,047.31	
Income for 1923, before depletion	525,577.55	
	$93,285,624.86	
Deduct depletion for 1923	4,409,094.26	
	$88,876,530.60	
Dividends declared	2,000,000.00	86,876,530.60
		$229,698,724.52

The company has consistently maintained its output at approximately 60 per cent of its capacity to produce, and though this policy has necessarily caused a slight increase in the cost per pound, it has conserved a large tonnage of ore which would otherwise have been mined without adequate return.

In 1923 the metals produced from the ores of branches and subsidiaries of the Phelps Dodge Corporation were 147,746,975 lb. of copper, 6,625,192 lb. of lead, 610,709 lb. of zinc, 2,034,416 oz. of silver, and 25,847 oz. of gold. There were also produced from purchased ores smelted, 3,569,185 lb. of copper, 241,949 oz. of silver, and 2,423 oz. of gold.

East Butte Copper Mining Co.

A report of the operations of the East Butte Copper Mining Co. for 1923 states that the year's operations resulted in a total loss of $93,120.46, compared with a loss of $134,343.21 for the previous year. These unfavorable results are traceable principally to inefficiency of labor occasioned by the scarcity of experienced men for underground work, and to the depressed condition of the copper market during the last six months of the year.

Development work on the 200 level of the gold property owned by the Pittsmont Copper Co. at Elkhorn, Mont., was a keen disappointment. Only 14,000 tons of commercial ore was obtained from this work, and as all ores carrying commercial values had previously been mined out above the 100 level, mining operations were discontinued on this property in September.

Satisfactory results were obtained from the lime quarry operations in 1923, the profits amounting to $11,044.02.

The gas well in Marion County, Kan., produced 14,162,000 cu.ft. of gas during the year. This well is nearly exhausted, however, and from present indications it is not believed that its life will extend beyond 1924.

At Silver Plume, Colo., from the beginning of the year until the mill was started in April, a few men were employed on development work.

Statement of Operations

Ore mined—Pittsmont, tons	94,669
Average assay value, per cent copper	3.25
Average assay value, silver, oz.	4.40
Cost of mining per ton, including development	$7.25
Company ore treated, tons	91,428
Custom ore treated, tons	131,958
Copper produced—Pittsmont smelter, lb.	13,674,932
Silver produced—Pittsmont smelter, oz.	776,705
Gold produced—Pittsmont smelter, oz.	692
Gold produced—Swissmont property, oz.	6,109
Gross value of metals shipped	$2,799,655.73
Other income	28,987.46
Gross income from all operations	2,828,643.19
Total cost of copper delivered New York	$2,881,112.67
Miscellaneous operations	9,196.17
Total cost of operations	2,890,308.84
Loss on mining operations	$61,665.65
Depreciation	1,646.49
Outside exploration	29,808.32
Total deficit all operations	93,120.46
Number of pounds copper produced	13,674,932
Price per pound received, New York	14.4017c
Cost of production per pound delivered New York	15.0030c
Loss per pound	.6013c
Price per ounce received for silver, New York	92.9376

Arizona Commercial Mining Co.

A report of the operations of the Arizona Commercial Mining Co. for 1923 shows an income before depletion of $290,542, as follows. One dividend of $132,500 was paid.

Income Account

Income—sales of metals		$1,235,598.20
Expenses		
Mining, treating, and refining	$813,438.86	
Selling, general	56,662.28	
Depreciation	67,964.17	
Interest	6,990.49	945,055.80
Income for 1923, before depletion		$290,542.40

Balance Sheet, Dec. 31, 1923

Assets

Fixed—mining properties and equipment		$4,112,322.91
Current		529,709.87
		$4,652,032.78

Liabilities

Capital stock—authorized, 300,000 shares of $5 each (265,000 issued)		$1,325,000.00
Current—accounts payable		72,210.94
Depreciation	$359,042.90	
Depletion	1,018,049.40	1,377,092.30
Surplus		
Balance Dec. 31, 1922	$1,897,111.82	
Income, before depletion	290,542.40	
	$2,187,654.22	
Deduct depletion, 1923	187,424.68	
	$2,000,229.54	
Dividend No. 9	132,500.00	1,867,729.54
		$4,642,032.78

Production amounted to 8,115,212 lb. of copper, 37,826 oz. of silver, and 2,143.4 oz. of gold from 75,721.8 tons of ore.

Development work will be carried on in 1924 in the upper levels and on the 18th level west, where a considerable tonnage of commercial ore should be discovered.

Expenditures for improvements have been limited to essentials and included the replacement of the 50-lb. rail with 75-lb. rail on about one mile of the railroad.

Inspiration Consolidated Copper Co.

A report of the operations of the Inspiration Consolidated Copper Co. for 1923 stated that operations were continuous throughout the year, with an average monthly production of 7,406,751 lb. of copper. The grade of ore mined during the year (5,135,116 tons) averaged 1.192 per cent. This average grade should be improved during the present year, as the Live Oak section, having higher grade ore, should be producing by July, 1924. The extensive program for the development of this orebody, the sinking and preparation of the Porphyry shaft, the surface equipment and extension of the railroad to handle this ore, as well as the construction of a townsite to house employees, in all calling for an expenditure of over $5,000,000, will be completed in July, 1924.

The cost of fine copper produced during 1923, including depreciation but excluding depletion and federal taxes, amounted to 11.6158c. per lb. of copper.

Income Account

Sales of copper		$10,779,319.66
Expenses		
Mining, including development	$3,589,939.98	
Reduction of ore	4,426,137.49	
Refining and selling	1,674,738.87	
Administration and federal taxes	289,262.02	
Copper on hand at beginning of year	1,520,481.23	
	$11,500,559.59	
Less copper on hand at end of year	3,008,271.90	
		8,492,287.69
		$2,287,031.97
Depreciation on buildings and equipment		399,964.55
		$1,887,067.42
Interest received		66,734.89
Income from investments		130,710.00
Balance, net income for year		$2,084,012.31

Balance Sheet Dec. 31, 1923

Assets

Fixed		$30,951,579.50
Current		
Supplies and prepaid expenses	$1,682,148.29	
Copper in process and on hand—at cost	3,008,271.90	
Accounts receivable	238,809.95	
Cash and cash assets	85,047.58	
		5,014,277.72
		$35,965,857.22

Liabilities

Capital stock: Authorized—1,500,000 shares of $20 each; issued 1,181,967 shares		$23,639,340.00
Reserve for depreciation		4,128,163.30
Current		2,205,880.34
Surplus		
Balance Dec. 31, 1922	$6,272,395.27	
Net income, year ended Dec. 31, 1923	2,084,012.31	
	$8,356,407.58	
Dividends	2,363,934.00	
		5,992,473.58
		$35,965,857.22

Mohawk Mining Co.

A report of the operations of the Mohawk Mining Co. for 1923 shows a profit of $150,297.73 before providing for depletion and depreciation. Dividends amounting to $315,000 were paid.

Balance sheet as of Dec. 31, 1923, follows:

Surplus Account, Dec. 31, 1923

Balance, Dec. 31, 1922		$1,609,589.04
Profit for 1923 before depletion and depreciation		150,297.73
Appreciation during 1923		166,436.56
Capital surplus		582,819.43
Transfer from reserve for contingencies		52,736.75
		$2,561,879.51
Less		
Depletion during 1923	$204,244.06	
Depreciation for 1923	90,302.46	
Dividends paid 1923	315,000.00	
		609,546.52
Balance, Dec. 31, 1923		$1,952,332.99

Income and Profit-and-Loss Account

Sales		
8,613,745 lb. of copper at 14.207c. per lb.		$1,223,771.77
Cost of Sales		
Copper on hand Jan. 1, 1923	$271,686.69	
Copper purchased from Wolverine Mining Co.	84,981.67	
Operating expenses	1,057,018.33	
Smelting, freight and New York expenses	216,547.29	
Taxes	75,047.77	
	$1,705,281.75	
Less copper on hand		
Dec. 31, 1923, at cost	572,139.18	
Net cost of copper sold		1,133,142.57
Profit on sales of copper		$90,629.20
Miscellaneous income		59,668.53
Profit before depreciation and depletion		$150,297.73

Summary of Results for the Year

Rock hoisted, tons	493,972
Rock stamped, tons	475,286
Product mineral, lb.	15,073,415
Product of refined copper, lb.	10,622,874
Yield of rock treated per ton, lb.	22.35
Cost per ton of rock hoisted	$2.14
Cost per ton of rock stamped	2.22
Total operating cost per pound of refined copper	9.950c.
Cost of taxes (exclusive of income and profits taxes)	.707c.
Cost of smelting, freight, and marketing product, including eastern offices' expenses	2.038c.
	12.695c.

Barnes-King Development Co.

A report of the operations of the Barnes-King Development Co. for 1923 states that operations, after charging off capital assets of $25,700.38, show a net profit of $49,774.80.

Profit on operation of Shannon property	$110,336.22	
Loss on operation of Kendall Power Plant	1,470.71	
Net profit on properties operated		$108,865.51
General expense and properties not operated	$64,722.66	
Less miscellaneous income	5,631.95	
		59,090.71
Net profit		$ 49,774.80

In addition to this the surplus of the company was increased $30,904.36 by the recovery of income taxes paid for the years 1917 and 1918. Operations for the year provide for the usual allowance for depreciation, computed on declining balances, which in total is $17,575.78.

The present surplus of $66,888.54 is reconciled with deficit of last year as follows:

Net profit for year 1923	$49,774.80	
Income taxes refunded	30,904.36	
		$80,679.16
Deficit Dec. 31, 1922	13,721.07	
Income taxes paid for 1921	69.55	
		13,790.62
Surplus Dec. 31, 1923		$66,888.54

All profitable ores in the Shannon mine were exhausted during the year, and the property closed in December.

The company has at present about $70,000 in cash and $200,000 invested in Liberty Bonds and U. S. Treasury certificates.

April Mining Dividends Decrease Owing to Low Copper Prices

The following dividends were paid by mining and metallurgical companies in April:

Companies in the United States	Situation	Per Share	Total
Bethlehem Steel	Various	$1.25 QB	$845,106
Cresson Consolidated Gold	Colo.	.10 Q	122,000
Eagle-Picher Lead pfd	Various	1.50 Q	15,000
Great Northern Iron Ore	Minn.	2.00 I	3,000,000
Homestake Mining, g	S. D.	1.50 MZ	376,740
Inland Steel pfd	Minn.	1.75 Q	175,000
Kennecott Copper	Alaska	.75 Q	2,090,341
Park City, s.l.z.	Utah	.15 Q	131,400
Park Utah, s.l.	Utah	.15 Q	150,000
Phelps Dodge, c	Various	1.00 Q	500,000
Republic Iron & Steel pfd	Various	2.75 QY	687,500
Silver King Coalition, s.l.	Utah	.30 Q	364,830
Sloss-Sheffield Steel & Iron pfd	Ala.	1.75 Q	117,250
Tecopa Consolidated, s.l.	Calif.	.01 Q	30,000
Tintic Standard, s.l.c.	Utah	.15 QX	176,205
Tonopah Extension, s.g.	Nev.	.05 Q	69,636
Tonopah Mining, s.g.	Nev.	.075 SA	75,000
United Eastern, g	Ariz.	.10 Q	136,300
U. S. Smelting, Refng. & Mng. pfd., s.l.	Various	.875 Q	425,556
Companies in other countries			
Ahumada Lead	Chihuahua	.15 Q	178,053
Asbestos Corporation pfd	Quebec	1.50 Q	60,000
Dome Mines, g	Ontario	.50 Q	238,333
Erupcion, l	Chihuahua	.15 Q	187,500
Hollinger Consolidated Gold	Ontario	.05 4 wks.	246,000
Howe Sound, c	B. C.	.05 Q	99,207
Kerr Lake, s	Ontario	.125 SA	75,000
N. Y. & Honduras Rosario, g.s.	Honduras	.25 Q	50,000
Nipissing, s	Ontario	.30 Q	360,000
Premier Gold	B. C.	.08 Q	400,000
Silversmith, s l.z.	B. C.	.01 Q	25,000
Wright-Hargreaves, g	Ontario	.025 SA	68,750
Total			$11,475,703

Q, quarterly; SA, semi-annually; I, irregular; B, also paid $1.75 on 7 per cent preferred and $2 on 8 per cent preferred; M, monthly; Y, includes $1 back dividend; X, includes 5c. extra; Z, includes $1 extra: g, gold; s, silver; c, copper; l, lead; z, zinc.

The total dividends paid during April showed a decrease of about $1,400,000 from those paid three months ago. Among the companies which passed their regular dividend were Anaconda ($2,250,000), Inspiration ($590,983), and Tennessee Copper ($200,000). Decreased dividends were paid by Republic Iron & Steel ($2.75 per share instead of $3.75); Tintic Standard (15c. instead of 25c.); United Eastern (10c. instead of 15c.); and Silversmith (1c. instead of 2c. per share).

On the other hand, Ahumada and Erupcion profited from high lead prices and increased their dividends 5 and 2½c. per share respectively and Silver King Coalition doubled its previous distribution. Great Northern Iron Ore Properties paid $2 a share, or $3,000,000 in all, the same amount that was paid in December. Homestake paid an extra dividend of $1 in addition to the usual monthly distribution of 50c. per share.

MINING STOCKS

Week Ended April 19, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb	....	....	*15	....	....
Anaconda	New York	33⅜	32¼	32¼	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	1¼	1	1	....	....
Ariz. Com'l	Boston	9⅛	8½	9	Ja.15, Ja.31	0.50
Calaveras	N. Y. Curb	....	....	1⅜	....	....
Calumet & Arizona	Boston	45½	44	45½	Mc.7, Mc.24, Q	0.50
Cal. & Hecla (New)	Boston	15⅜	15⅛	15⅜	Dc. 1, De. 17	0.50
Canario Copper	N. Y. Curb	2 3/16	2 1/16	2 3/16	....	....
Cerro de Pasco	New York	46¼	43¾	44¼	Ap. 17, My. 1	1.00
Chile Copper	New York	27⅛	26½	27⅛	Mc.1 Mc.29, Q	0.62½
Chino	New York	16½	16⅜	16½	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	2⅜	2⅜	2⅜	....	....
Copper Range	Boston	23½	22⅛	22⅝	Ap. 18, My. 2,	1.00
Crystal Copper	Boston Curb	75	70	75	....	....
Davis-Daly	Boston	*46	*41	*45	Mar. '20, Q	0.25
East Butte	Boston	4⅜	4½	4½	Dec. '19, A	0.50
First National	Boston Curb	29	26	29	Feb. '19, SA	0.15
Franklin	Boston	*90	*75	*75	....	....
Gadsden Copper	Boston Curb	....	....	*40	....	....
Granby Consol	New York	13¼	12½	13	May '19, Q	1.25
Greene-Cananea	New York	14	13½	14	Nov. '20, Q	0.50
Hancock	Boston	1	1	1	....	....
Howe Sound	N. Y. Curb	2⅛	2⅛	2⅛	Ap.1, Ap.15, Q	0.05
Inspiration Consol	New York	25⅛	24	25	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	3⅞	3½	3½	May 23, K	0.15
Isle Royale	Boston	15⅞	14¾	15½	Se. 1, Se. 15,	0.50
Jerome Verde Dev.	N. Y. Curb	1⅛	1⅛	1⅛	....	....
Jib Consol	N. Y. Curb	*24	*21	*23	....	....
Kennecott	New York	38	36	37⅞	Mc.7, Ap. 1, Q	0.75
Keweenaw	Boston	†1⅛	*80	*80	....	....
Lake Copper	Boston	1⅝	1	1	....	....
Magma Copper	New York	33¼	32⅜	33¼	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅝	1⅝	1⅝	....	....
Mass Consolidated	Boston	†*75	†*50	*50	Nov. '17, Q	1.00
Miami Copper	New York	22	20¾	22	My.1, My.15, Q	0.50
Michigan	Boston	....	....	*50	....	....
Mohawk	Boston	*30	*28	*30	Se. 22, Oc. 13,	1.00
Mother Lode Coa	New York	8⅛	8	8	De.14, De.31	0.50
Nevada Consol	New York	13⅝	12⅞	13⅜	Sept. '20, Q	0.25
New Cornelia	Boston	17⅝	17¼	17⅜	My.9, My.26, Q	0.25
New Dominion	N. Y. Curb	2⅞	2⅞	2⅞	....	....
North Butte	Boston	3	2⅞	2⅞	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*70	*66	*66	....	....
Old Dominion	Boston	17¾	17¼	17⅜	Dec. '18, Q	1.00
Osceola	Boston	....	....	31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†130	†120	....	Mc.24, Ap.2 Q	1.00
Quincy	Boston	19	19	19	Mar. '20, Q	1.00
Ray Consolidated	New York	10⅛	9⅝	10	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*15	*15	*15	....	....
St. Mary's Min. Ld	Boston	*34⅛	*31	*34⅛	Ap.22, My.22, K	3.00
Seneca Copper	New York	1⅞	1	1⅛	....	....
Shannon	Boston	*35	*35	*35	Nov. '17, Q	0.25
Shattuck Arizona	New York	5⅜	5	5⅛	Jan. '20, Q	0.25
South Lake	Boston	....	....	*25	....	....
Superior & Boston	Boston	†*75	†*50	*50	....	....
Tenn. C. & C. cfs	New York	7	6⅞	7	De.31, Ja.15, Q	0.25
Tuolumne	Boston	†*40	†*30	*42	May '13,	0.10
Utah Copper	New York	67⅛	65½	65½	Mc.14, Mc.31, Q	1.00
Utah Metal & T	Boston	†*40	†*30	*45	Dec. '17,	0.30
Victoria	Boston	....	....	*65	....	....
Walker Mining	N. Y. Curb	3⅛	3 1/16	3⅛	....	....
Winona	Boston	....	....	*20	....	....
Wolverine	Boston	....	....	5⅜	....	....
NICKEL-COPPER						
Internat. Nickel	New York	12⅞	12⅜	12½	Mar. '19,	0.50
Internat. Nickel pfd.	New York	79	78¼	78½	Ap.17, My.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	5⅜	2⅞	5¼	....	....
National Lead	New York	130	125½	127	Mc.14, Mc.31, Q	2.00
National Lead pfd	New York	....	....	114	My. 23, Ju. 14, Q	1.75
St. Joseph Lead	New York	24½	24	24	Mc. 20, 24	0.50
ZINC						
Am. Z. L. & S.	New York	8	7⅞	7⅞	May '20	1.00
Am. Z. L. & S. pfd	New York	26	26	26	Nov. '20, Q	1.50
Butte C. & Z.	New York	5	4⅜	4⅞	Ma.. '23,	0.50
Butte & Superior	New York	16⅛	15⅛	16	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld	New York	4⅛	4	4⅛	Dec. '20, Q	0.50
New Jersey Zn	N. Y. Curb	143	140½	140½	Ap.30, My.10, Q	2.00
United Zinc	N. Y. Curb	....	....	*25	....	....
Yellow Pine	Los Angeles	85	85	85	Mc. 28, '24	0.04
SILVER						
Alvarado	N. Y. Curb	....	..	1⅛	....	....
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12
Beaver Consol	Toronto	*23	*22½	*22½	May '20, K	0.03
Castle-Trethewey	Toronto	*76	*76	*76	....	....
Coniagas	Toronto	2.10	2.10	2.10	Ap.20, My.1	0.02½
Crown Reserve	Toronto	....	....	*60	Jan. 17,	0.05
Keeley	Toronto	2.30	2.24	2.30	....	....
Kerr Lake	N. Y. Curb	....	....	1⅞	Ap.1, Ap. 15, Q	0.12
La Rose	Toronto	†*15	†*14½	*14	Apr. '22,	0.10½
McKinley-Dar.-Sav.	Toronto	†*14	†*13½	*13	Oct. '20, Q	0.03
Mining Corp. Can	Toronto	†3.40	†3.30	3.35	Sept. '20, Q	0.12
Nipissing	N. Y. Curb	6	5⅞	5⅞	Mc.1, Ap.21, Q	0.03½
Ontario Silver	New York	6⅞	6⅝	6⅝	Jan. '19, Q	0.50
Temiskaming	Toronto	*29	*28	*28	Jan. '20, K	0.40
Tretheway	Toronto	14	13½	14	....	....
GOLD						
Alaska Gold	New York	....	....	⅛	....	....
Alaska Juneau	New York	1⅜	1¼	1¼	....	....
Argonaut	Toronto	†*47½	†*46	*48	....	....
Carson Hill	Boston	1⅜	1¼	1⅜	....	....
Cresson Consol. G	N. Y. Curb	3⅞	3 13/16	3 13/16	Mc.3, Ap.10, Q	0.10
Dome Mines	New York	16⅞	16	16⅜	Mc.26, Ap.21, Q	0.50
Golden Cycle	Colo. Springs	1.34½	1.34½	1.34½	De.'22,	0 2
Hollinger Consol	Toronto	13.15	12.95	13.05	Ap.3, Ap.21, M	0.5
Homestake Mining	New York	51¼	48⅝	48⅝	Ap.19, Ap.25, MX	1.50
Kirkland Lake	Toronto	....	....	21⅛	....	....
Lake Shore	Toronto	3.85	3.84	3.84	Fe.2, Fe. 24, Q	0.02
McIntyre-Porcupine	New York	15⅜	15⅜	15⅜	Ap. 1, My. 1,	0.25
Newray	Toronto	32½	32½	32½	....	....
Portland	Colo. Springs	*63	*62	*62	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1½	1 3/16	1⅛	....	....
Tom Reed	Los Angeles	33½	29	29	Dec. '19,	0.02
Tough-Oakes	Toronto	69	67½	69	....	....
United Eastern	N. Y. Curb	*70	*63	*64	Ap 10, Ap.28, Q	0.10
Vipond Cons	Toronto	1.14	1.12	1.12	....	....
Wright-Hargreaves	Toronto	3.00	3.00	3.00	Mc.15, Ap. 1, Q	0.02½
Yukon Gold	N. Y. Curb	*69	*69	*69	June '18,	0.02
GOLD AND SILVER						
Con. Cortez	N. Y. Curb	*48	*46	*48	....	....
Con. Virginia	San Francisco	4½	2½	4½	....	....
Continental Mines	N. Y. Curb	....	....	2½	....	....
Dolores Esperanza	N. Y. Curb	*37	*37	*37	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2	2	2	Mc.28, Ap.5	0.08
Tonopah Belmont	N. Y. Curb	*50	*50	*50	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*29	*29	*29	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	1 1/16	1⅞	1 1/16	Mc. 11, Ap. 1	0.05
Tonopah Mining	N. Y. Curb	1⅜	1⅜	1⅜	Ap. 6, Ap. 21	0.07½
Unity Gold	N. Y. Curb	1⅜	1¼	1⅜	....	....
West End Consol	N. Y. Curb	*60	*57	*59	Mar. '23, Q	0.05
SILVER-LEAD						
Ahumada	Boston Curb	6	5⅜	6	Mc., Ap. 2, X	0.1
Bingham Mines	Boston	†17	†15	15	Sept 19, Q	0.25
Cardiff M. & M.	Salt Lake	....	....	95	Dec. '20,	0.15
Chief Consol	Boston Curb	3½	3½	3½	Ap 19, My. 1, Q	0.10
Columbus Rexall	Salt Lake	....	....	*24	Aug. '22	0.03
Consol. M. & S.	Montreal	35⅞	34½	35	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	....	....	205	July '20	0.10
Erupcion	Boston Curb	2⅛	2⅛	2⅛	Mc. 15, Ap.2, X	0.15
Federal M. & S.	New York	....	....	11	Jan., '09	1.50
Federal M. & S. pfd.	New York	43	42½	43	Fe.26, Mh.15, Q.	1.75
Florence Silver	Spokane	*19	*17	*18	Apr. '19, QX	0.01
Hecla Mining	N. Y. Curb	8⅞	8⅞	8⅞	My.15, Jn.15,	0.25
Iron Blossom Con	N. Y. Curb	*29	*28	*29	Oct. 26, '23,	0.02
Marsh Mines	N. Y. Curb	....	....	*9	June '21, I	0.02½
Park City	Salt Lake	....	....	4.75	Mc.15, Ap.1	0.15
Park Utah	N. Y. Curb	....	....	3½	Mc.15, Ap.1	0.15
Prince Consol	Salt Lake	....	....	*75	Nov. '17,	0.02
Silversmith	Spokane	*43⅛	*42⅞	*43⅛	Ap. 1, Ap. 10	0.01
Tamarack-Custer	Spokane	1.95	1.88	1.95	Se.30, Oc. 1, K	0.02
Tintic Standard	Salt Lake	4.45	4.45	4.45	Mar. 25, 24, QX	0.15
Utah-Apex	Boston	2⅞	2⅞	2⅞	June '23, QX	0.50
IRON						
Bethlehem Steel	New York	51	47⅝	50½	Mh. 1, Ap. 1, Q	1.25
Char. Iron	Detroit	....	....	3	....	....
Char. Iron pfd.	Detroit	1⅜	1⅜	1⅜	....	....
Colorado Fuel & Iron	New York	30⅝	28¼	30⅝	Fe.11, Fe.25 Q	2.00
Col. Fuel & Iron pfd.	New York	....	....	102	Fe.11, Fe.25, Q	2.00
Gt. North'n Iron Ore	New York	28	27⅛	27⅛	De.10, De.27	2.00
Inland Steel	N. Y. Curb	....	....	46	Mh.15, Apl. 1 Q	0.62½
Mesabi Iron	N. Y. Curb	5⅛	4⅝	5	....	....
Replogle Steel	New York	8½	8½	8½	....	....
Republic I. & S.	New York	47⅜	44½	46⅜	May '21	1.50
Republic I. & S. pfd.	New York	86	86	86	Mh.20, Ap.1 QX	2.75
Sloss-Sheffield S.&I	New York	58	56½	57	Mc.10, Mc.20	1.50
Sloss-Shef. S &I.pfd.	New York	80	80	80	De.20, Ja.2, Q	1.75
U. S. Steel	New York	98¾	95½	98½	Mc. 29, QX	1.75
U. S. Steel pfd.	New York	120	119¼	120	Mc. 29, Q	1.75
Virginia I. C. & C.	New York	47	46	46	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	77	77	77	De.15, Ja.22	2.50
VANADIUM						
Vanadium Corp.	New York	23⅜	22	23	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	28½	28	28	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	....	....	58½	Ap.1, Ap.15, Q	1.50
SULPHUR						
Freeport Texas	New York	9⅞	8½	9	Nov '19, Q	1.00
Texas Gulf	New York	59	58¼	59	Mh.3, Mh.15 QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3½	3¼	3¼	....	....
MINING, SMELTING AND REFINING						
Amer. Metal	New York	42½	42	42½	Fe.18, Mh.1, Q	0.75
Amer. Metal pfd.	New York	109⅜	109⅜	109⅜	Fe.20, Mh.1, Q	1.75
Amer. Sm. & Ref.	New York	61	58¼	60⅜	Ap. 11, My. 1, Q	1.25
Amer. Sm. & Ref. pfd.	New York	99½	99½	99½	My. 9, Jn. 1.	1.75
U. S. Sm. R. & M.	New York	19½	19½	19½	Jan. '21, Q	0.50
U. S. Sm. R. & M. pfd.	New York	38½	38	38½	Ap.15, '24, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial, X, Includes extra.

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